ENGINEERING NEWS

THE RAPID TRANSIT BILL, sent to the Legislature by Mayor GRANT, of New York, provides for the appointment of five commissioners by the Mayor. This commission is presumedly to be made up of experts, and is to have power to locate lines through the blocks, avenues, or streets of the city, excepting only certain streets and parks as named in the original act. It will fix the amount of annual compensation to be paid to the city by any company to be organized for operating a road, and the commissioners are also required to prepare articles of association for any such company. The bill provides for obtaining the consent of one-half of the property-holders along any line; or application may be made to the Supreme Court for the appointment of three commissioners, who can condemn such property. With consent obtained, the Commissioners of the Sinking Fund are required to sell at public auction, to the highest bidder, the rights, franchise, and privileges of any authorized railway. Any bid may be rejected, and the road resold until a fair price is obtained.

A NEW LOCATION FOR THE GREAT CUT of the Nicaragua canal project has recently been surveyed which straightens the line materially, saves about 1,800 ft., or over a third of a mile, of distance, and saves as nearly as may be (by a rough estimate of our own from the profile) 1,500 to 1,600 ft. of the cut at its average depth, or almost exactly ten per cent., the entire length of the cut being about 15,600 ft. or 2.96 miles. Short as this cut is, it is by far the heaviest part of the work, its cube rising to upwards of 8,000,000 cu. yds. of solid rock, and would probably require at least a year longer to complete than any other part of the work. The importance from every point of view of saving ten per cent. or thereabouts of such a cut can be appreciated. The prospects of the canal project appear to be extremely bright, as will more fully appear shortly, unless we are entirely mistaken.

ANDREW CARNEGIE, according to an article from his pen in a recent number of the *North American Review*, does not believe in any legislation or united action to prevent the construction of parallel railway lines. If current reports can be believed, he now proposes to prove his faith by his works, and intends to secure a new line from Pittsburg to Lake Erie over which the ore used by the Carnegie works at Pittsburg will be shipped. As the story goes, Mr. CARNEGIE and his friends have secured control of the Valley Ry. of Ohio, running from Cleveland south 75 miles; the Lake Erie, Alliance & Southern Ry. from Bergholz to Phalanx, O., 61 miles; and the Pittsburg, Chartiers & Youghiogheny R. R., near Pittsburg. It is proposed to build a connecting link between the first two roads from Canton to Paris, 11 miles, and to build also from Bergholz across the Ohio River and West Virginia Panhandle in a direct line to Pittsburg. It is quite possible that after he has this road built, if indeed he concludes to undertake the enterprise, Mr. CARNEGIE may after all find it cheaper to patronize the low-grade direct routes to Lake Erie than to haul his supplies over the heavy grades of the round-about route just outlined.

ANOTHER NEW ROUTE from Pittsburg to Lake Erie has just been opened over the Cleveland & Canton and the Pittsburg & Western roads. A bridge across the Cuyahoga river at Kent, O., and a ¾ mile link connecting the two roads have just been finished. The distance from Cleveland to Pittsburg by the new route is 155 miles.

THE PROPOSED INCREASE IN THE WATER SUPPLY OF Rochester, N. Y., has reached a point where the construction of an additional conduit from Hemlock lake, as recommended by the engineer experts, Messrs. FTELEY and FANNING, has been endorsed by the joint committee, and a bill has been framed asking for authority to issue bonds to the extent of $1,500,000 for this purpose. Mr. EMILE KUICHLING will be chief engineer of the new work, and he is named as one of the three commissioners to have the matter in charge.

THE SYRACUSE, N. Y., WATER COMMISSION have framed a bill to be presented to the State Legislature, which provides for the issue of $3,000,000 of bonds, to be expended in establishing water-works, with Lake Skaneateles as a source of supply. The bill empowers the Mayor to appoint six commissioners to have this matter in charge.

A SHIP CANAL is proposed across the Upper Peninsula of Michigan, beginning at Bay Autrain, in Lake Superior, and terminating in Little Bay de Noquet near Gladstone. The canal would be 36 miles long, but it would decrease the distance between Duluth and Chicago by 271 miles. The canal would have only two locks and Mr. W. H. MORRELL, the projector, says it would cost less than the proposed Government improvements at the Sault Ste. Marie canal.

A SHIP RAILWAY SCHEME has been presented to the Toronto Board of Trade by Mr. KIVAS TULLY, proposing to connect Toronto with the Georgian Bay.

AN ERICSSON MONUMENT, to cost $10,000, was voted by the New York Legislature on Monday last. The probable location will be on the Riverside Drive.

THE BROOKLYN BRIDGE received in February, $74,880.81 from promenade, carriageways, and railway, $69,406.82 coming from the latter source. The expenditures during the same month were $48,297.23. Of this amount, $19,020.17 was for the February payroll, and $3,124.94 for salaries. The bulk of the money was paid out to the Brooklyn Trust Co., on certificates of indebtedness for property on the line of the bridge. No steps whatever have yet been taken toward carrying out plans for enlarging traffic facilities.

THE ST. JOHNLAND SEWER is reported well built, by Messrs. EMERY, TOWLE and MCELROY, the engineering experts appointed by the Brooklyn Board of Supervisors to examine it. While the original plans and specifications were departed from in some instances, Contractor FREEL did good work all around; all the changes were made on the authority of the engineer, Mr. CAREY.

COAL MINING IN KENTUCKY is increasing very fast, according to the report of State Inspector C. J. NORWOOD for the year ending Dec. 31, 1888. The output in 1887 was 1,800,000 tons. In 1888 it was 2,223,447 tons, an increase of about 425,000 tons or about 23 per cent. These figures do not include the local mines in the State, as the mining law does not provide penalties for failure to report, and there is thus a very considerable tonnage not included therein. In 1880, according to the United States census, the total production in Kentucky was 950,000 tons.

THE ADDYSTON PIPE & STEEL WORKS, at Addyston, Ohio, is said to be the largest pipe works in the world. The pipe foundry is 1,000 ft. long by 168 ft. wide, and nine other buildings are 225×150 ft. each. The company makes its own gas, and uses gas as fuel to operate the hydraulic machinery used in handling the pipe. The pig-iron comes from Alabama, Tennessee, and Georgia, and the capacity of the works is now 85,000 tons of manufactured material per annum. The works cover 110 acres and practically support a town of 6,000 inhabitants.

THE CONGO RAILWAY, from Matadi to Stanley Pool, is now practically decided upon to connect the upper navigable river with the channel below. The estimated length is 168.0 miles and the engineering difficulties are very considerable, the line being crossed by deep ravines and large rivers. Across the M'Poso river a bridge 256 ft. span and about 70 ft. above the water will be required; bridges must also be built across the Lufu, a tributary of the Congo, and the still wider Kullu river. It is expected that work will be commenced as soon as the dry season sets in, and its completion will probably consume three years. The estimated cost is between $5,000,000 and $6,000,000.

CHINESE LABOR is in demand in Siberia, and the Russian Government offers every facility to Chinese immigrants. Such labor is cheap, and without it the Siberian railways can not be built in the time required.

THE TEHUANTEPEC SHIP RAILWAY CONCESSIONS have been amended by Mexico by a promise to guarantee 5 per cent. interest on $60,000,000. In case the earnings of the company do not reach the requisite amount, or $3,000,000, the Mexican Government is to make up the deficiency.

A FLORIDA CANAL, from St. Augustine to Lake Worth, has been examined and reported upon by E. L. CORTHELL, C. E. The length of the canal would be about 340 miles, and the channel 6 ft. deep. The canal would be used for drainage and for communication between the plantations rapidly increasing along the proposed line. Mr. CORTHELL is reported to have concluded that the canal is practicable and within the limits of economy.

THE PENNSYLVANIA R. R. Co. is reported to have bought 3,660 ft. of water front in Greenville and Bayonne, on New York Bay, for $600,000. A bill is now before the New Jersey Legislature giving shore owners the right to fill out to deep water, which is here 11,800 ft. away. When the authority is obtained, the ground will be filled and docks built, and the entire through freight business of the company will be transferred to this point. The improvements are estimated to cost $9,000,000.

AN EAST RIVER TUNNEL is the object of a bill introduced in the New York Legislature last week. The bill does not locate the tunnel other than to say that it is intended to connect New York and the Eastern Districts of Brooklyn.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision March 19 on the Intercolonial Railway, near Rimouski, P.Q., between an express train and a special freight train, which had been delayed by snow-drifts. Both engines and several cars were wrecked, and 4 men were killed.——Another serious collision occurred on the East Tennessee, Virginia & Georgia Railroad at Caswell's Station, Tennessee. The front section of a freight train had stopped to take on some more cars, and through some misunderstanding the second section was not flagged in time. Several cars were wrecked, and the engine was derailed. One man was killed.

A TRESTLE on the Cincinnati & Green River road, near Stanford, Ky., gave way March 14, under a freight train, and the engine and 2 cars fell a distance of 30 ft. Two men were fatally injured.

AN INTERNATIONAL CONGRESS OF APPLIED MECHANICS is to be held in Paris, during the present year, as a part of the Universal International Exposition of 1889. The five members from the United States are Messrs. ROBERT GRIMSHAW, R. H THURSTON, THOMAS EGLESTON, and the Presidents of the American Societies of Civil and Mechanical Engineers. Among the important subjects for discussion are the unification of horse-power, choice of materials in machine construction, mechanical production and utilization of artificial cold, etc., etc.

THE NORFOLK & WESTERN RAILROAD Company has for nearly two years been making surveys for an extension from a point on the New River branch, at the Forks of the Elkhorn river, across the southern part of West Virginia to Ironton, O., a distance of 125 miles. The line runs through a district remote from railways, and taps mineral deposits of great richness. The whole line, including the site for a bridge across the Ohio river at Ceredo, W. Va., has been carefully located, ready for the letting of contracts. It is now announced that the funds for constructing the line have been secured and that a large force will be put at work on the grading within two months.

THE CONTRACTORS FOR THE WASHINGTON AQUEDUCT tunnel, Messrs. BECKWITH & QUACKENBUSH, threaten to sue the United States for money due them for work done. The amount is $180,000, and they charge that the bad work in the tunnel was done by sub-contractors who were paid on the Government estimates, and that cement and material were paid for by them sufficient to do good work. They formally protest against being held responsible for any bad work done since Dec. 5, 1887, at which date the work was finally approved and accepted by the Government officers.

A CONSOLIDATION OF POUGHKEEPSIE BRIDGE companies is proposed. The present control is vested in five separate corporations, viz.: the Hudson Connecting R. R., 27 miles long; the Poughkeepsie Bridge Co.; the Poughkeepsie & Connecticut R. R., 26 miles long; the Hartford & Connecticut R. R., 108 miles long; and the Springfield & Massachusetts R. R., about 20 miles long. Nearly all of the stock of these roads is owned by the

bridge syndicate. The proposed capital stock of the new company is $8,000,000, and authority to grant the consolidation has been obtained from the State of Delaware.

ELECTRICAL ACCUMULATOR PATENTS were the subject of a decision rendered lately by Judge COXE in the U. S. Supreme Court. The case was the electrical Accumulator Co. vs. The Julien Electric Co. for an infringement of storage battery patents. As an outcome of the decision, the first-named company claims that its Faure patent is sustained for improvements in secondary batteries or accumulators, and it further claims that the Julien, Gibson, Woodward, Pumpelly and Macreon companies all use batteries tributary to the Faure invention. On the other hand, the Julien company asserts that the suit was on four patents. One was abandoned during the trial, two were decided invalid, and two claims only of the fourth were in controversy. One of these claims it was held the defendant did not infringe, and the other the Court holds is too broad in its present form, and can be sustained only when limited by a disclaimer to a device which the defendant does not use. In other words, the Julien claims a victory, too, insomuch as the one claim sustained does not affect its invention.

THE EADS SHIP RAILWAY CO. has been granted by the Mexican Government the changes asked for in its original concession. These changes were required by foreign capitalists; and with these secured it was claimed that these capitalists would guarantee $60,000,000, the estimated cost of the ship railway.

THE BOYDEN AUTOMATIC BRAKE, now being experimentally used on the Baltimore & Ohio Railroad, as we have recently noted in connection with a description of the brake, was again tested last week with a train of engine, tender and 4 cars—a very short train for a brake test, but the same as is to be hereafter regularly run between Baltimore and Frederick. One stop from 40 miles per hour is stated to have been made in 180 ft. on a level grade, which appears like a practical impossibility, requiring as it does a brake efficiency of about 30 per cent. of the load on braked wheels. The brake is said to be very easily graduated in running down hill, and to be doing excellent service.

ANNISTON, Ala., is now one of the great railway supply depots. The United States Rolling Stock Company, located at that point, has orders on hand for 6,000 cars.

THE idea that railroad directorship is a private snap rather than a public trust has been one of the fundamental evils in bringing about the prevailing distrust of railroad securities.—*Financial News.*

THE PENNSYLVANIA RAILROAD COMPANY has placed in a conspicuous spot alongside their tracks at Horseshoe Bend the old time canal boat which they bought for their exhibit in the great parade at the Constitutional celebration in Philadelphia last spring. It bears an appropriate inscription about that style of transportation having preceded the Pennsylvania Railroad Company in crossing the Allegheny mountains. The ancient craft, now very gayly painted, attracts considerable attention on passing trains. It is said the company is soon to place a Conestoga wagon beside the canal boat.

A REMEDY FOR DAMP WALLS.—A German architectural journal publishes the results of experiments made to determine the efficacy of a paraffin wash for damp walls. These results are in the highest degree satisfactory, the protection afforded being in every case complete. The wash consists of solid paraffin (paraffin wax) dissolved in heavy coal-tar oil, in the proportion of one part of the former to two and a half to three parts of the latter. The wax is melted by the application of a gentle heat to the oil, and kept melted during use by placing the vessel containing the compound in hot water.

THE BOSTON MANUFACTURERS' MUTUAL Fire Insurance Co. makes the following remarkable showing in its recently issued report for 1888.

Average per cent. of premium lost:

1851 to 1877, inclusive	33.38
1878 to 1888, "	23.03
Difference	10.35

The average reduction in rates on all risks taken from 1878 to 1888, inclusive, in consideration of increased safeguards, is computed at 7 cts. per $100. The sum of such computed reduction is $393,073.00

The actual gain to members in the diminished proportion of losses of 10.35 per cent. comes to 581,186.00

Total $974,259.00

This company has carried somewhat less than one-fifth of the whole amount insured by the Factory Mutual companies. Other companies have gained proportionately as much as this company. On this basis the gain due to concurrent inspection and better safeguards against fire, in ten years, has been about $5,000,000. This gain is more fully treated in the Joint Report of all the Factory Mutual Companies.

The average rate of premium is now about 90 cts. per $100, having been reduced 5 to 25 cts. five years ago.

The report is accompanied by a detailed list of the circumstances attending 210 fires, the great majority (all but 60) of which were too unimportant to be followed by claims for damage, the main causes being as follows:

Foreign matter in stock	54
Friction of stock	14
Hot journal	20
Gears	6
Chafing of belt materials	1
Spontaneous ignition of oily material	24
Other spontaneous ignitions	19
Sparks	14
Steam pipes	4
Other causes	74
Total	210

The Construction of Gasholder Tanks.

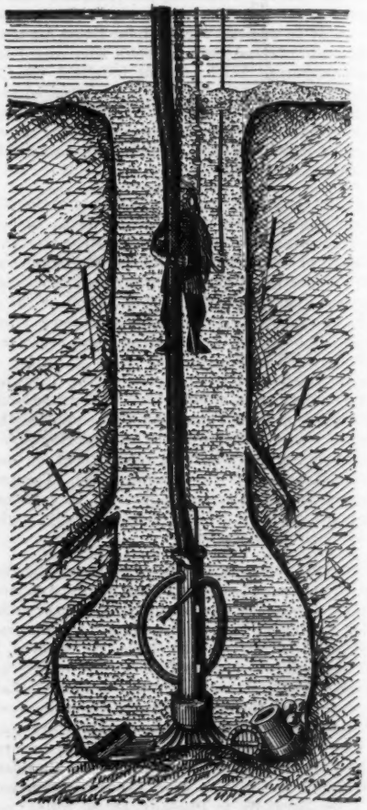
At a meeting of the association of Birmingham students of the Institution of Civil Engineers, held Feb. 20, Mr. C. HUNT, M. Inst. C. E., read a paper on "The Construction of Gasholder Tanks," in which he pointed out that at the present time the largest tanks were made of brick or concrete at a depth of between 50 ft. and 60 ft., with an extreme diameter of 250 ft.; but it is evident that the limits of size have not yet been reached. The London clay, of all subsoils, is perhaps the best for tank construction, because it can be worked into a basin impermeable to water; it affords a solid foundation, when undisturbed by water, for the tank walls; and its angle of repose being very slight, the pressure it exerts upon the back of the walls is quite inconsiderable. The cost of gasholder tanks must bear an intimate relation to the ground in which they are constructed, quite apart from any question of superior skill or economy in design. For small gasholders, where the excavation is likely to prove exceptionally difficult and costly, cast or wrought iron tanks, especially the former, are frequently adopted. Until within a comparatively recent period, bricks and stone were exclusively used in the construction of a tank, but concrete is now very largely employed. Each of these materials is suitable with clay puddle or cement rendering, the selection depending upon local circumstances. Great care has to be taken in deciding the thickness of the walls, as they have to perform the function of retaining walls by sustaining the whole weight of the earth behind them; yet the rule for obtaining the thickness of a retaining wall cannot apply, because of their curvature. Mr. HUNT described at some length the construction of the Windsor St. and other tanks. The following table was given, showing cost of tanks of various kinds:

Description and locality of tank.	Diameter.	Depth.	Cost of tank.	Cost per 1,000 cu. ft. cap.
	ft. in.	ft. in.	£	£
Brick and puddle tanks, Birmingham	82 0	20 9	1,902	17.3
Do.	97 0	20 9	2,250	14.7
Do.	102 0	24 9	3,482	19.2
Do.	102 0	24 9	3,430	18.9
Do.	142 0	24 9	5,850	15.3
Do.	185 0	41 0	18,190	16.5
*Do.	200 0	37 0	16,800*	14.4*
*Do.	200 0	37 0	20,800*	17.8*
Salford†	154 0	40 0	11,700	15.7
Fulham	243 0	32 0	10,000	7.3
Kennington-lane	218 0	44 6	21,448	12.9
Beckton	195 0	37 6	15,000	13.4
Leicester	172 0	37 0	15,200	16.5
Brick tank, Bolton‡	142 6	32 0	7,036	14.0
Concrete and puddle tank, Nine Elms, London	200 0	45 0	17,600	13.4
Concrete and rendered tank, Old Kent-road, London	218 0	55 6	20,300§	9.8

* Inclusive in each case of £1,200 for timber framing to the gasholder crown.
† Puddle found on site. No pumping.
‡ No puddle; a cavity between two walls filled with hydraulic mortar.
§ Inclusive of £1,800 for timber framing, valves, etc.
* From report in *The Engineer.*

Submarine Excavation in Sand.

In the last issue of *Le Génie Civil* is an illustrated description of the method adopted for recovering treasure from the man-of-war *Lutine*, which was wrecked upon a sand-bar in 1799, off the coast of Holland. Several attempts have been made to recover this treasure, which is valued at $6,000,000, and in 1800-01 about $200,000 in gold and silver bars was taken out of the wreck. All further effort was abandoned until 1886, when some further delving resulted in obtaining the comparatively small sum of $4,340. The apparatus here described is the invention of the Dutch engineer, W. H. TER MEULEN, and preliminary trials with it promise rapid and most gratifying results when applied on the site of the wreck.



The Ter-Meulen Sand Excavator.

The system adopted agrees in some respects with that used by M. VETILLARK for sinking great blocks of artificial stone in the construction of harbors, and was proposed for the extension of the port of Calais. The apparatus of Engineer MEULEN is shown in the accompanying illustration. It is made of a strong hose 7.2 in. in diameter, to the lower end of which is suspended a heavy cylinder of cast iron, about 5 ft. long, which terminates in a copper, perforated cover through which water, under a heavy pressure, is forced through the hose and against the bed of sand. The weight of the metal portion of this apparatus is about 550 lbs., and the hose, which is attached to the steamboat carrying the plant, is kept in a vertical position even in a strong current. It may be said here that the sand overlying the wreck is 25 ft. deep, and the total loss of weight in the apparatus due to this immersion is nearly 350 lbs.

On the steamboat is an engine of 40 H. P., and a steam pump with a delivery of 500 galls. per minute under a pressure equivalent to a static head of 60 ft. It is expected that, with this pressure, a well can be sunk in 25 ft. of sand in about 9 minutes, and maintained in the condition shown for a sufficient length of time to allow a diver to descend to whatever may be uncovered. To assist the diver in his search, and to enlarge his field of operation, a second and smaller hose is attached to the iron cylinder, and this water-jet is under his control; with it, a chamber 10 or 12 ft. in diameter may be secured.

The cut is supposed to show the well just as the

sinking apparatus has reached the bottom, and experiments prove that as soon as this point is reached, and the water-jet ceases to sink, the action of the water upon the sand tends to enlarge the diameter of the hole by disengaging masses of sand from the sides. This sand, as soon as it is loosened, is at once transformed into a liquid mass.

The pressure of the water forced in by the pump tends to preserve the stability of the walls of the well. For this hole, being made at the bottom of the sea and in a bed of sand, is filled with sand-bearing water, and the artificial pressure of the ascending water column has a very considerable sustaining power. For this reason, and from the further fact that detached sand masses are at once dissolved, no dangerous caving in is apprehended. The depth of the well and the force of the water-jet must be duly proportioned, however, to ensure the safety of the diver. Beds of clay or mud occurring in the sand would be somewhat dangerous, as they may tend to deflect the ascending water column. And for better security, under these conditions, it is best to enclose the mouth of the jet in a strong wire netting and a screen of rope so arranged as to serve as a guide to the ascending water.

The diver in his dress should weigh at least 500 lbs. And so that he may not be too much fatigued by this necessary weight, the latter should be arranged in part in the form of belts loaded with leaden plates and these belts in turn attached to a chain leading to the surface. At the bottom of the well and under the moving sand, the excess of weight is not necessary, and he can detach the loaded belt before going to work. If the sand becomes too thick, the diver tends to ascend rather than to sink; and if the water becomes too clear, he signals to the boat to send him less water. The ordinary breast and back plates, weighing about 100 lbs., are kept in place at all times. The preliminary experiments made at Ymuiden show that the walls of the well stand very well and are hard to the touch. The water does not escape easily because of the cloud of liquid sand in the upper part of the well. In decending, the diver first meets a pretty thick liquid, but at the bottom the water is limpid and the obscurity is complete, no light whatever penetrating the mass.

While the text does not mention any such intention, it would seem that an electric light could be used with advantage at the bottom of the sinking tube, if the water is as limpid there as described.

Rainfall in the Western Arid Regions.

(*Concluded from page 237.*)

Gen. GREELEY then points out that it is probable that the maximum rainfall on mountain slopes or rapidly rising grounds is at an elevation of about 3,000 ft., as in Europe, and that as a large proportion of the stations are in the lowest plateaus and passes of Utah, Nevada, and California, where the rain-fall is the least, it is tolerably safe to assume that the average rainfall through the arid region, as shown by his maps, is really less than the average amount which actually falls. As to cloud-bursts he says:

It is well known that enormous quantities of water occasionally fall in these arid regions, the phenomena being known as cloud-bursts. The quantities which fall in a single cloud-burst cannot be calculated, but the amount can be expressed by no other word than enormous. In southeastern California, in the desert country where it has been said that no rain falls, one cloud-burst was of such extent that, although the country was nearly level, yet water fell in such enormous quantities that over a quarter of a mile of the Southern Pacific Railroad was completely swept away and other portions of the track submerged and damaged. It is to be noted, also, that this quantity of rain fell during one of the dry months, when the rain map showed for southern California only .01 or .02 in. of rain, barely enough to moisten the surface of the sandy desert.

A list of a dozen other phenomenal cloud bursts is then given, all tending to show that there are large local rainfalls which are not caught by the gauges, and the report continues:

The Chief Signal Officer puts it forward as his opinion that when Idaho, Nevada, Utah, New Mexico, and Arizona shall have been covered with rain-gauges as completely as New York or New England, the final outcome of observation will indicate that actual average of rainfall for this arid region is now understated by the census harts from 30 to 40 and by these from 10 to 15 per cent.

The statements as to the much-disputed question of the level of Great Salt Lake are especially interesting:

The systematic and careful observations made by Prof. G. K. GILBERT, of the Geological Survey, supplemented by other data for the past 40 years, which he has collated and sifted, gives with tolerable accuracy the level of the Great Salt Lake, which serves as a reservoir for probably two-thirds of the entire territory of Utah, as well as for a considerable portion of Idaho. A chart kindly furnished by Prof. GILBERT shows that Salt Lake fell from 1845 to 1849; rose to 1856, fell to 1860; rose to 1873 and fell, with a slight interruption, until 1884, and rose until 1886, since which time it has a slightly falling tendency. It is significant that while the first two minima were substantially the same in 1849 and 1860, yet the minimum of 1884 is at about the same height as the maximum of 1856, and is over a foot above the maximum of 1845. As the country adjacent to the lake is substantially level, it follows that any increase in the height of the water must be most gradual, since the area of the lake, and consequently the evaporating surface of the water, is largely increased. This consideration would not be so important in some portions of the United States, but in a region where the annual evaporation cannot be far from 6 or 7 ft., it is a very pertinent fact.

The changes in the level of Salt Lake are perhaps best shown by five-year periods, beginning with 1845. The elevation above zero (lowest water-level) for five-year periods is as follows:

	Feet.		Feet.
1845 to 1849	2.1	1870 to 1874	12.6
1850 to 1854	3.4	1875 to 1879	11.5
1855 to 1859	5.2	1880 to 1884	6.4
1860 to 1864	3.6	1885 to 1889	8.2
1865 to 1869	9.6		

It is a significant fact, which may however be overrated, that the greatest and most rapid rise of the water of Salt Lake occurred between the years 1862 and 1870; that is to say, during the period when the amount of land being brought under cultivation and the quantity of vegetation and the number of trees was most largely increasing. This increase of height in Great Salt Lake continued, too, despite the fact that irrigating canals were being brought into extensive use, so that large quantities of water, which otherwise would have run into the lake, were diverted to watering the irrigable lands and were absorbed by the soil or evaporated in the dry air of that region.

As respects effect of forests on rainfall, Gen. GREELY expresses the view that they have a slight favorable effect, but not so large as is often claimed.

The following very interesting report on Kansas rainfall is quoted from a report by Prof. HENRY A. HAZEN, of the Signal Service, who, having previously examined this question, was thought to be best informed upon it:

The subject has already received attention at the hands of Prof. C. A. SCHOTT, who decided in 1876 that up to that time there had been a slow and steady increase of precipitation since the earliest authentic records, which go back to about 1837. He also thought that probably the maximum or turning point had been reached, and that there would be some diminution from that time on.

In 1883 an investigation of this question by the present writer showed a diminution of precipitation in 1879, but a marked increase for the three succeeding years. Taking the mean of each five years, we find the following values and deficit or excess:

Half-decade.	*Mean.*	*Deficit or excess.*
	Inches.	*Inches.*
1837-'41	31.42	−3.10
1842-'46	29.32	−5.20
1847-'51	33.35	−1.17
1852-'56	31.28	−3.24
1857-'61	35.37	+0.85
1862-'66	30.34	−4.18
1867-'71	38.83	+4.31
1872-'76	38.66	+4.14
1877-'81	41.11	+6.59
1882-'86	35.58	+1.06
Mean	34.52	

It should be noted that the period of observation is not sufficient to enable a perfectly satisfactory deduction, but it is plain there has been a marked increase in precipitation during the last twenty years. The apparent falling off in the last five years is not unexpected, and does not indicate a permanent diminution, as it is mostly due to the small amount in 1886, and there have been four annual records previously, with a greater falling off than in 1886. We may conclude that the scarcity of rainfall in 1886 is not unprecedented, and that from past observations there is no proof of a permanent diminution in precipitation. Many more years' observations will be needed to establish a marked secular variation.

We may consider that opening up the land to tillage, planting trees, and general covering of many square miles with vegetation that were formerly barren wastes has a tendency to retain the moisture from the clouds, and this in turn renders the air slightly more humid, so that there has been an actual increase in the rainfall; and so long as these favoring influences continue, there is no danger of a relapse to former conditions. A diminution for one or two years will be followed by an increase, and the average precipitation will continue to increase.

A proof of the general increase of moisture in the soil is given in the biennial report quoted above, in the fact that, notwithstanding the increase of springs emptying into the water courses, there seems to be a tendency to a less flow of water in the streams. This seems to show a retention of moisture in the soil and a consequent increase of springs.

On the strength of all the facts here roughly abstracted, Gen. GREELY expresses the following important opinion:

The Chief Signal Officer does not hesitate to express the opinion that the trans-Mississippi and trans-Missouri rainfall is slightly increasing as a whole, though in certain localities it may be slightly decreasing from causes set forth above, and it seems most proper for him to put forth his strong conviction, even if it be not a certainty, when, as in this case, it will tend to reassure the agricultural population in the lately drought-stricken districts of the West. There appears no possible reason to believe that the scanty rainfall of the past year or two will not be followed by increasing precipitation in the next few years, which will maintain the annual rainfall of these sections at the average, or even increase it. It is believed that the interests of the entire country will be subserved by the publication of a large edition of the rainfall charts and tables accompanying this report.

The Recent Mineral Development of the United States.

Under this heading a recent issue of *Industries* has the following editorial, which we think will be read with interest. Pounds sterling we render into dollars at the rate of $5 to £1.

There is nothing in the history of industrial progress that is more remarkable than the recent growth of the mineral and metal industries of the United States. The output of copper, lead, silver, and gold in that country has long since been phenomenal, and has passed beyond the limits that have either been attained, or are capable of attainment, by any other country. But now we are even threatened with being surpassed by the United States in the extent of our output of iron and steel. The make of pig iron in the United States last year is estimated to be within 100,000 tons of the make in this country, being about 6,500,000 tons. The output of manufactured iron has long been almost abreast of our own, with which it runs a close race. As regards coal, the output of the United States has now risen to about 120,000,000 of tons, or about 40,000,000 under that of the United Kingdom. The increase of output in 1887, alone, is computed at close on 10,000,000 of tons. Between 1882, which was a prosperous year, and 1887, which was a more prosperous year still, the increased output of coal in the United States, was: bituminous coal, 17,565,000 tons; anthracite, 4,220,000 tons. All this has occurred, notwithstanding the substitution over a large area of consumption, both for domestic uses and for manufactures, of the natural gas which is so remarkable a feature of the modern life of Pittsburg and other Pennsylvanian towns. The revolution which the discovery and application of this product have brought about has been almost entirely a thing of yesterday. In 1882, the total consumption of natural gas in the United States was officially valued at $215,000. In 1887, the consumption had increased to a value of $13,582,000. In the interval, therefore, there had been an increase of about 63 times the quantity used at the earlier period. The consumption of natural gas is universal in certain districts of Pennsylvania. It is not only employed in iron and steel works, in glass works and in other factories, but it is used both for lighting and warming in dwelling houses, and its use is daily increasing. The element of uncertainty as to its duration invests the application of this product with a sufficient amount of speculative interest to place it in a category by itself. As yet the supply appears to be inexhaustible, and the fortunate people of Pittsburg and its neighborhood are reaping the result in the form of a purer atmosphere and a more economical supply of light and heat. But for the development of the use of natural gas over the last five or six years, it is probable that the consumption of coal would have been 10,000,000 tons to 12,000,000 tons a year more than it is to-day, in which case, we should have witnessed the output of the United States within 25,000,000 tons of that of the United Kingdom.

The petroleum supply of the United States, unlike that of natural gas, does not appear to increase. Between 1882 and 1887 it decreased from 30,000,000 to 27,250,000 bls., notwithstanding that in the interval, the average price per barrel had fallen from 78 cts. to 60 cts. This is, no doubt, mainly due to the competition of the Russian supplies furnished by the region of the Caspian Sea. But

the production could perhaps hardly be expected to keep up the same rate of increase as it had done during the previous 17 years. In 1870 the output of petroleum was only 185,250,000 galls., whilst in 1887 it was nearly seven times that quantity. Between 1864 and 1877 the value of the exports of petroleum from the United States had increased six-fold. The quantities exported have steadily increased during recent years, but the reduced prices have kept the annual values of the exports from advancing in the same proportion. The annual value of the exports of petroleum at the present time may be taken at $50,000,000 a year.

No records exist from which we can calculate the quantity of iron ore annually raised in the United States; it is, however, estimated by the most competent authorities at about 12,000,000 tons a year. The rate of increase in regard to this mineral has been as phenomenal as that of either coal or petroleum. The census returns showed the output in the census year 1880 to be only 7,120,000 tons. In that year the imports of iron ore into the United States amounted to 493,000 tons. Adding these two items, we get a total of 7,613,000 tons, and as the production of pig iron in the United States in the same year was 4,295,000 net tons, it follows that the consumption of ore per ton of iron made was about 1.8 tons. If we apply this figure to the 6,417,000 tons of iron produced in 1887, the output of ore in 1887 would come out as about 11,000,000 tons, after deducting imports. The imports of iron ore into the United States in 1888 were practically *nil*, and as the output of pig iron has increased, the quantity of iron ore produced in 1888 must have been about 12,000,000 tons, as estimated above.

In 1880, the average official value of iron ore was as much as $3.12 per ton, which compares very unfavorably with $1.32 per ton for the United Kingdom, $1.18 per ton for Germany, 54 cts. per ton for Luxembourg, and 94 cts per ton for France. Of course, it is probable that the ron ore supplied to the furnaces of the United States taken as a whole, is of a higher quality than that obtained in this country—at least as regards its average contents of iron—but the difference in this respect, whatever it may be, is by no means sufficient to compensate for the remarkable difference in prices; and so long as this latter difference lasts, the United States will probably be shut out from effectual competition in the iron and iron ore markets of the world. The United States have, however, enough to compensate them for this probable exclusion, in their mineral wealth in other directions, as will be seen from the following statement of the values of the principal metallurgical products of the world not already referred to, and the proportions thereof contributed by the United States in 1887:

	Total Annual Value.	*Proportion Contributed by United States*
Gold	$105,800,000	$33,100,000
Silver	124,420,000	53,141,000
Copper	49,500,000	21,062,500
Lead	23,820,000	14,460,000

In some other minerals of industrial importance the United States is producing much larger quantities from year to year. The following examples will suffice:

	Production of United States in 1882.	*in 1887.*
Manganese ore	3,500 tons	34,524 tons
Pyrites	12,000 "	52,500 "
Ochre	7,000 "	20,000 "
Limestone	332,000 "	480,000 "

On the other hand, however, within the same interval, the production of quicksilver, nickel, New Jersey marls, asbestos, graphite, and one or two other minerals of minor importance has been reduced. It requires no great gift of prophecy to see what is the "manifest destiny" of the United States in reference to some, at least, of the useful metals. The coal resources of the United States are greater by far than those of any other countries that have the slightest industrial importance. In all but half a dozen of the States and Territories coal is found under circumstances that admit of its being easily and economically worked, and in some districts the cost of getting coal is not greater than in the United Kingdom. In Pennsylvania it is often less than in our own country, while coke is generally sold at a lower rate than with us. Another ten or twelve years, at the outside, and the United States may be expected to be ahead of our own country, so far as its coal production is concerned. With an increased production of coa will certainly come an increase in manufactures, and consequently in industrial importance; but, except in copper and lead, which are so high priced as to stand a heavy freight, the United States are hardly likely, we think, to interfere with England in neutral markets.

ARTESIAN BORINGS IN BURMAH.—*Indian Engineering* reports that a tube-well 250 ft. deep was sunk at a mill in Pazundaung, and three others on the Dabaung side of the Pazundaung creek, both near Rangoon. The supply from these is excellent. An unsuccessful attempt at boring was made at Dalla, where drinking water is now obtained from shallow tanks. Further attempts will be made at the latter place, which is also near Rangoon, but on the other side the river.

Prices of Dredging Contracts.

The following is a nearly complete list of the prices of the accepted bids on dredging contracts which we have published between Feb. 25 and Feb 2, 1889, with the names of the successful bidders. It will no doubt be examined with interest by engineers and contractors. The varying prices are largely due to varying conditions, which are in part explained in connection with our detailed records of the bids, but we cannot undertake to cover such matters in a condensed tabular abstract.

1889		Cu. yds.	Cents per cu. yd
Feb. 2	Harlem River, J. W. Flaherty		30
Jan. 19	Wilmington Harbor, Cal. Inside Island	85,000	94
" "	" " Outside Deadman's I	80,000	$1.50
" 10	Back Cove, Portland, Me, Edward Moore		25
" "	Lubec Channel, " " A. R. Wright		35
" "	Mooseabec bar, " " " "		40
" "	Rockport Harbor, " E.P. Lovering		20
" "	Camden " " " "		25
" "	Penobscot River, " Moore & Wright		55
" "	Narragaugus River, " A. R. Wright		30
" "	Bellamy River, N. H., T. Symonds		35
" 8	Hyannis Harbor, Mass., Atlantic Dredge Co		32
" "	Wareham " " " " "		24
" "	New Bedford, " " " " "		24
" "	Newport " R. I., J. H. Fenner		34½
" "	Pawtucket Riv. " Brainard Bros.		35¾
" "	Pawcatuck " " J. H. Fenner		40
" "	Green Jacket Shoal, Providence, R. I., A. Dredge Co		14
" 7	Choptank Riv., Md., Atlas Dredge Co	28,000	28
" "	Cambridge Harbor, Md., C. T. Caler	25,000	18½
" "	Duck Cr., Del., F. C. Somers	50,000	19
" 9	Georgetown Harbor, S. C., P. Sanford Ross		32.9
" "	Waterway between Beaufort Har. & New Riv. N. C		37
" "	Beaufort Har., N. C., C. T. Caler		37½
" "	Waterway bet. Beaufort & Newbern		30½
" 19	Outside of piers from pier 56 to pier at 23d St., New York		70
" "	Pier 6, East River, N. Y., Union Dredge Co		20
" 26	Vicksburg Harbor, Miss., W. R. Blackman		12 & 15
" 3	Oakland, Cal., city front		32.95
" "	" " jetty channel		13.95
" 12	Ludington, Mich. Dredging foundation for pier		30
" "	Mosquito Cr., S. C. Dredging and removing (some over 2 miles)		35, 36, 38 & 40
" "	Portage Lake Harbor., Truman & Cooper	60,000	10
" "	Cape Fear River, Atlas Dredge Co	984,000	12½
" "	" " " "	496,000	12
1888			
Dec. 29	Ticonderoga River, N. Y., Luther Whitney	15,000	11
" "	Otter Cr., Vt.	14,000	14
" "	Oakland, Cal. In canal, San Francisco Br. Co		17.7
" "	" " " basin " " "		14.7
" "	Galveston Bay, Tex., ship channel	700,000	12½
" 18	Assawoman Bay, Del., Hanes & Miller		17½
Nov. 24	50,000 cu. yds. dredging Niagara River	50,000	17
" 22	Grand Marais, Mich., M. H. Fitzpatrick	100,000	19½
" 21	Buttermilk Channel and Gowanus Bay, N. Y. H. Dr. Co		15
" 14	Saginaw River	10,000	45
" "	" " West channel		28
" "	" " Bar at mouth		50
" "	Duluth Harbor, Williams, Upham & Co	200,000	15
" "	St. Louis Bay, Minn., " " "	250,000	13½
" "	Grand Marais Harbor, Wis " " "	65,000	24
" "	Superior Harbor, Wis., C. S. Barker	278,000	14
" 20	Norfolk Harbor, Va.,		12½
" 10	Plattsburg Harbor, N. Y	28,000	13
" 2	Misillion Cr., Del., F. C. Somers		35
" 10	Plymouth Harbor, Mass		20⅞
Oct. 31	Gloucester " "		30
" 27	James River, Va., sand and gravel	500,000	16
" 10	Calumet River, Ill., Burdick & McMahon	80,000	22
" "	" " " W. A. McGilliss & Co	770,000	11¾
Sep. 13	Mobile, Ala., Ala. Dredging & Jetty Co		9
Oct. 13	Schuylkill River, American Dredg. Co		19
Sep. 22	Hudson River, Albany, P. W. Myers	7,000	16
" "	Oversbaugh " E. M. Payne	23,000	17⅞
Aug. 29	Albany basin	140,000	24½
" "	Hudson River, Round shoal		23½
" "	" " Arsenal dock		35
" "	" " Bogert Light		16⅞
" "	" " Parda hook		15½
" "	" " Troy		38
" "	" " Stone house, P. W. Myers	600	16½
" 4	" " New Baltimore Light, P. W. Myers	18,000	14
" "	" " Mulls Light, E. M. Payne	25,000	15.9
" "	" " Bath shoal, Lane and Brummelkamp		25
July 21	" " Kellogg shoal		25
" "	" " Washington bar		25
June 30	Baltimore, Md., channel and harbor		14
" "	" " In basin and docks		15
" "	" " Spring gardens		15.7
" 2	Thames River, Conn., Hartford Dredging Co		19
Apr. 14	Dredging for flushing tunnel, Milwaukee		27
Feb. 25	New York, Pier No. , East River		20
	Average of all above prices 27.58 cents		

The Bender Propeller.

The Doylestown (Pa.) *Democrat* gives a description of a new propeller, designed by HENRY C. BENDER, a carpenter living in Bucks County, Pa. In the duck, the goose, the muskrat, and other water animals, he noticed the propelling power is well underneath, and about midway of the body to be moved. Acting on the suggestion, Mr. BENDER's paddle-wheels are placed under the boat, about midships, one on each side the keel, where the blades always act on solid water. This gives the boat much greater pulling power. When the blades of the wheel leave the water, they revolve in an air-tight drum, and are relieved of the task of lifting and carrying around a body of water. The action of the engine being direct, and dispensing with the long shafting required for the old paddle-wheels and the screw, there is great saving of power; less danger of breaking machinery; more room for storage of merchandise; and greater speed secured. As the boat moves through the water with great steadiness, causing the least possible swell, this method of propulsion seems especially adapted to canal navigation. It is claimed that this propeller gives greater speed and increases the propelling power; prevents rocking and slip, being at all times in the water; economizes room by dispensing with shafts, boxes, and accompaniments, and avoids the delay arising from the heating of shafts and journals; causes no swell or wash, and propels the vessel with greater steadiness. Finally, lighter engines can be used to secure the same speed, the vessel can be turned on its center, and the motive power being beneath, is completely protected. The *Democrat* says: "The trial trips of the *Advance*, a 33-ft. launch, on the Schuylkill, sustain all these points of excellence. It moved through the water in almost perfect stillness, the only disturbance being the ripple at the bow. Two weeks ago, the officers of the company took the model, a thoroughly equipped nickel-plated miniature steamboat, to Washington, and displayed it in the basement of the House of Representatives. Its working was exhibited before members of the Senate and House and Naval Committees, and many other members of Congress, the Admiral of the Navy and naval officers, the Superintendent of the Life Saving Service and many others. We are justified in saying that

all, including naval experts, who saw the model steaming along its artificial waterway, were delighted with it. Its wonderful pulling power was a subject of remark."

Are Railways Necessary in China?

Chinese railways, and the needs of a railway system in China, are discussed by Mr. WM. H. DUNLOP in a late issue of *Blackwood's Magazine*. Mr. DUNLOP says that the average railway promotor seems to forget that the Empire is already provided with a network of natural and artificial water-ways that only require individual lines to supplement these channels of trade. In other words, systematic railway development by long trunk lines and feeders is not called for, and he denies that there is any urgent commercial necessity for railways in China except at a few well-defined points. But he also affirms quite as vigorously the desirability of intersecting the navigable rivers, and especially of building the line from Canton to Pekin. With an extension from the latter city to Kalgean on the frontier of the Desert of Gobi, Mr. DUNLOP thinks that the overland trade of a wide stretch of country, unsupplied with water communication, could be enormously increased.

In discussing the problem of railway financiering in China, Mr. DUNLOP says that the Chinese Government will not be moved by commercial necessities to construct railways, for it does not recognize such necessity, but its recent experience with France, and its inability to transfer troops from one part of the Empire to another, has led to a desire for strategic railways. But herein lies the difficulty: the latter class of roads are not constructed to pay, and foreign credit can only be secured for military roads by an ample security for the interest, and in the present state of Chinese financial administration, such security can hardly be had. Want of revenue is not the trouble with the Government so much as the want of honest collection of this revenue in the provinces.

Mr. DUNLOP is also convinced that, unless under European management, a railway in China would commence going to the dogs at the start; and this management would be essential for the protection of the investor. But on the other hand military roads under European management, in case of war between China and a European Power, would be liable to be deprived of their principal officials at the time they were most needed; hence the difficulty of reconciling the conflicting railway interests in China. The author recommends his English readers to see what can be done in replacing the slow junks on the rivers rather than to scramble for railway concessions, which may be long delayed, if ever built upon at all.

WIND-PRESSURE CONSTANT.—Mr. WM. FERREL, in a letter to *Science*, calls attention to the following notes on the subject of wind-pressure. The old formula among English and American engineers for obtaining the force of the wind from its velocity, is to assume that the product of the wind's velocity in miles per hour into the factor .005 is the pressure in pounds in each square foot of resisting surface. This formula is used alike at sea-level and on mountain-tops and in the extreme temperatures of winter and summer. The factor was determined by ROUSE, from experiments made 150 years ago; and though it has been since shown to be an extreme value, and in error, it is still tenaciously adhered to by many engineers and meteorologists. Mr. FERREL showed, in 1881 and in 1887, that the theoretical value of the factor was .0027, not considering friction, and he did not think that this latter element in air could increase it to .005. Late and yet unfinished experiments by the Royal Meteorological Society now show that the average value of this factor is .003, which is only one-tenth greater than the theoretical value above given, and agrees with the previous conviction of experimenters, that friction could not increase this value more than one-tenth, or, at most, one-eighth. The attention of engineers is especially called to the experiments now being made in this direction.

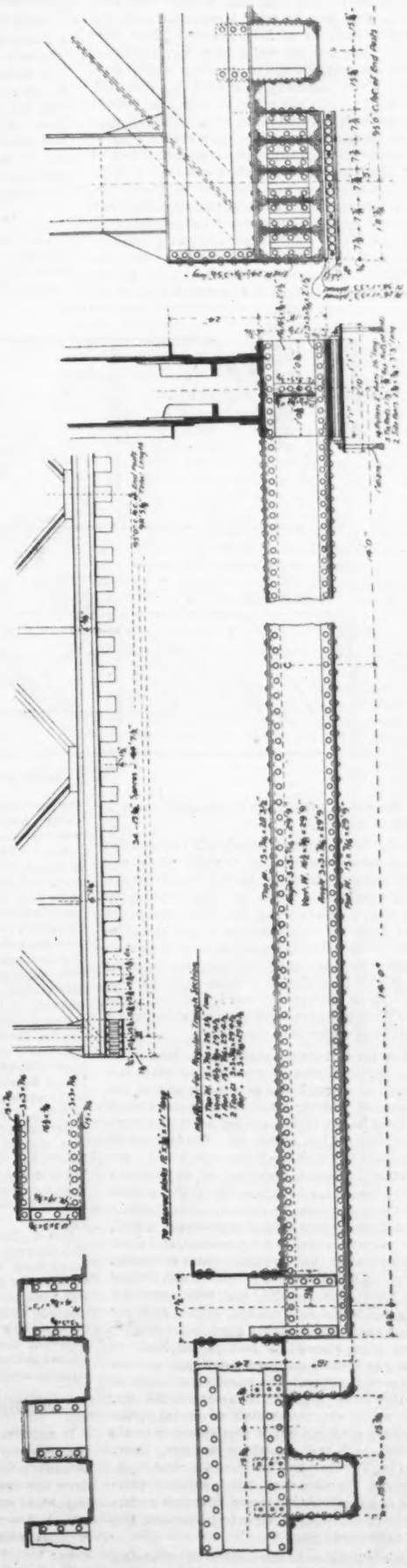
UPON the value of railroad property depends the value of all other property; and when this fact is more clearly recognized, legislation may show less injustice to railroad capital.—*Financial News.*

Iron and Ballast Bridge Floors.

The New York Central & Hudson River Railroad has been showing a progressive spirit in many ways of late years, and in none more so than in the solidity and strength of its bridge construction. As we have before announced, it is now building or refitting many of its short-span bridges with solid "buckle-plate" or plate iron floors over which the ballast is carried uninterruptedly, thus completely doing away with the evils inseparable from open wooden bridge floors, however solidly constructed, and also giving the bridge a better chance for long life by increasing its ratio of dead to live load.

Such a floor is considerably more expensive than wood; it is idle to deny or blink at that fact; but then, a reference to our pictures and account of the St. George disaster in our issue of March 9 will show that it has certain compensating advantages, while a reference to our account of the La Salle disaster, in this issue, will show that it hardly pays to study lightness too much.

The total weight of the floor illustrated is 1560 lbs. per lin. ft. for iron work only, the ballast and ties being extra. The details and general construction are so clearly shown on the cut as to need no further description. The truss itself for which this particular floor was designed presents no features of special novelty or interest, unless it may be the massive end post, which looks as if it had been designed to resist the impact of a locomotive, as it actually was. We therefore illustrate only this detail of the truss itself. The details of the floor vary more or less, of course, with each bridge, but that shown is the general type of a goodly number of structures constructed and proposed.



Iron and Ballast Bridge Floor, New York Central & Hudson River Railroad.
WALTER KATTE, Chief Engineer; GEO. H. THOMPSON, Bridge Engineer.

The Quality of Linen Fire Hose.

The Associated Factory Mutual Insurance Companies, of Boston, in their joint report for 1888, present a report from Mr. JOHN R. FREEMAN, Engineer and Inspector, on the above subject. The investigation was made under instructions from Mr. EDWARD ATKINSON, the President of the Boston Manufacturers' Fire Insurance Co. The immediate cause was the discovery that in one of the latest and best-appointed mills a line of hose was lately discovered which, on careful test, was found to leak through the pores of the fabric, in a length of 150 ft., a quantity of water much in excess of that delivered meanwhile at the nozzle. An examination of about 1,000 ft. of hose in another mill showed that 900 ft. leaked so excessively as to be deemed worthless.

In a visit to dealers in this article in Boston and New York, it was found that perhaps three-fourths of them kept a low-grade hose in stock, as an alternate, in case the purchaser deemed the high-grade article too expensive. The price ranged from 10 cts. to 35 cts. per ft., exclusive of couplings; and one quotation was noted of 5¾ cts. per ft. for a 2½-in. linen hose, with an old-style shank-coupling wired on for $1.50 per set, or about half the price of a good coupling.

Samples 150 ft. long were then secured from each grade manufactured by each American maker, and two or three samples of Scotch hose. These were tested for strength to resist bursting, tightness, and freedom from excessive sweating under pressure, and proper cleaning of the flax by thorough boiling in alkali. While some of this hose proved to be made from tow and some from second-quality flax, microscopic examination showed that none of the samples contained any appreciable admixture of jute or Italian hemp. As showing that a hose, though cheap and very poor, may be "all linen," we have the statement of a prominent flax-spinner that his firm manufactures "all flax" twines, the price varying with the amount of tow and quality of the flax from 18 cts. to 75 cts. per lb. Good linen 2½-in. hose weighs about ¼ lb. per linear ft.; so that the bare cost of the unwoven yarn in a piece of *thoroughly first-class* 2½-in. linen hose is about 12 to 15 cts. per ft.

Under the bursting test, nearly all the samples showed a resistance, when new, of about 243 lbs. per sq. in., and several of the best samples rose to 600 lbs. As hose is exceedingly liable to deterioration by dampness and long standing, the 150-lb. test is not sufficient; under all the conditions of use and idleness, even when never intended to be subjected to greater water pressure than 100 lbs., the bursting strength of new hose should average fully 400 lbs. per sq. in. As to tightness, it was found that some of the best makers were unwittingly manufacturing a high-cost hose which was very leaky.

In the test for tightness, samples 10 ft. long were laid in an inclined trough arranged to catch all water escaping through the pores; one end of the hose was capped, and the other end connected with a rubber-lined hose which conveyed a hydrant pressure of from 60 to 75 lbs. per sq. in. The leakage in the first minute and first 5 minutes was noted. Before the end of 5 minutes the fibre had swelled and reduced the leakage, so the results of the second and third 5 minutes were also taken. The tightest hose was a Scotch piece from Dundee, with ¼-gall. in the first minute, under 60 lbs. pressure, and practically nothing after that (actually about 0.02 galls. per minute). After alternately wetting and drying this hose five times, the leakage was generally about 1½ galls. in the first minute, with ⅛-gall. per minute after that. On the other hand, some equally high-priced hose showed a leakage as high as 13 galls. in the first minute, and 1 gall. per minute after 10 minutes' soaking. The bursting strength of the "Rob-Roy Hose" (the Scotch hose) was 393 lbs. per sq. in., which was not as high as several of the best American makers; but it was superior to all in tightness. Of the American makers, Ross, Turner & Co., The Eureka Fire Hose Co., and G. A. EBERLE, under the advice of the insurance companies, and as a result of these tests, have now undertaken experiments with a view to perfecting the process of manufacturing.

The chemical tests as to the method of cleansing stock by alkali boiling are not conclusive, and their publication is deferred in fear of doing an injustice to some manufacturer.

The experiments made seem to show that the only way to be sure of the quality of linen fire-hose is to test it under the practical conditions of use. To this end, and to avoid wetting all the linen hose in a mill for trial, a "Specification for Linen Fire-Hose" is offered, and mills are urged to buy their hose direct from the manufacturer, and to select two or three reliable makers and induce them to manufacture hose for the members of the association under the following

SPECIFICATIONS FOR LINEN FIRE-HOSE.

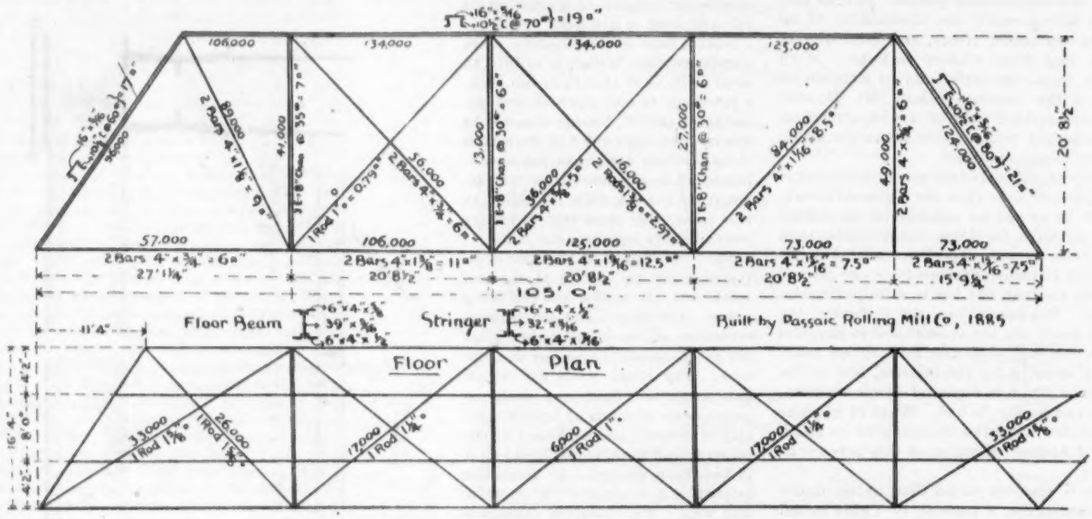
Item 1. Each piece of hose to have a distinct and conspicuous trademark, consisting of colored warp-threads woven into the fabric of the hose.

Item 2. The name of the manufacturer, together with the year of manufacture, to be stencilled upon each and every piece of this hose once in each 15 ft. of length, with black letters, at least 1¼ ins. in height.

Item 3. Each web of hose to be numbered serially as it comes from the loom, and this number to be also stencilled on each 50-ft. section of the hose; and each of those hose manufacturers to agree to maintain an apparatus for testing the bursting strength and amount of sweating of hose under a pressure of 75 lbs., and to agree to test a sample at least 3 ft. in length, taken from each web as it comes from the loom; this 3-ft. sample to be cut, preferably not from the end, but from some intermediate point, when cutting the web up into 50-ft. sections. A record is to be kept of these tests.

Item 4. The maker to guarantee: First, that hose bearing his name and trademark shall not, on delivery, burst at a water pressure less than 400 lbs. per sq. in.; hose to be wet under pressure for from 10 to 20 minutes before bursting. Second, that after having been wet under a pump or hydrant pressure of 75 lbs. and thoroughly dried, then, on being subjected a second time to a water pressure of 75 lbs., the total leakage during the first minute shall not exceed 1-6 gall. per foot in length, and that upon this second trial, after the hose has been wet for 5 minutes, the total leakage during the next 5 minutes shall not exceed .01 gallon per foot in length; the water pressure meanwhile being 75 lbs. per sq. in.

Item 5. The manufacturer of the hose to guarantee that the yarn from which the hose is woven has been procured from a first class and responsible manufacturer, whose name is given, under a written guaranty that it was spun from first-quality linen, and that it has been cleansed by boiling in soda-ash solution of a strength obtained by a weight of soda equal to at least 1-10 of the weight of the yarn, for at least 3 hours; then properly washed in clean water, and then boiled again, in a similar alkaline solution, for 2 hours more.



Strain and Section Sheet, La Salle Bridge.

The Bridge Failure at La Salle, N. Y.

It appears from later and more correct reports that the newspaper accounts of the circumstances attending the failure of this bridge, from which we drew our own account of last week, were in several important respects incorrect. We have since ascertained, however, what we believe to be the exact circumstances of the disaster, which were as follows:

The east bound Lehigh Valley freight train No. 128, consisting of 18 cars, reached this bridge at about 10 A. M., Sunday, March 10, moving at the rate of about 20 miles per hour. While the train was on it, the bridge suddenly collapsed. The engine and forward part of the train had just reached the east abutment, and the engine with 3 loaded refrigerator cars kept the track, though the draw-head on the last of these cars was pulled out. The following 2 cars, being the fourth and fifth in the train, also reached the east abutment, but were thrown off the track, and lay on their sides on the *south* or right-hand side of the track. The following 8 cars, one a loaded refrigerator, and the last empty box and gondola cars, went into the creek. Then 2 more box cars fell on their sides on the west side of the opening, on the right-hand side of the track also, and the remaining 3 cars held the track. No one was injured.

The cause of the wreck cannot be positively determined. An eye-witness, who viewed the scene from the station about 600 ft. from the bridge, said that a car about the middle of the bridge "suddenly commenced to jump up and down," and instantly the structure fell.

The bridge in falling rolled over toward the north, and lay with the floor system upside down on top, showing that the north truss gave way first. In falling, the rails on the abutments were pulled out of place by their connection with the rails on the bridge, which accounts for the derailment of the cars on each side of the opening. This displacement of rails extended back 35 to 40 ft. on the west side of the opening. There were no marks on the ties indicating that any car was sufficiently far off the track to strike the end-post, and no marks to show that a car went off on the *north* side (towards which the bridge fell) in any case. Everything goes to show that the wreck was the result of a sudden breaking (perhaps of a brake beam or bolster) *on* the bridge, causing a car to "slew" around and strike the north truss.

The bridge was tied with good 8 x 10-in. oak ties, about 8 ins. apart in the clear, with oak guards 6 x 8 ins. notched down 1 in. on the ties and bolted to every other tie. The guard timbers did not flare at approaches nor were there any snubbing posts or rerailing guards at the ends of the bridge; but, as will be seen from the above account, it is almost certain that none of these things would have been of any use in this particular case, if present.

Most of the débris has been fished up, and so far, no broken axle or wheel has been discovered. Several trucks were found very badly broken, but it is impossible to tell, of course, what broke before and what after the bridge was struck.

One thing is very apparent, if there be no serious error in the facts as here narrated (which is hardly possible), that the bridge collapsed with amazing suddenness, on very slight provocation. To determine if possible to what extent this was due to legitimate faults of design, and to what extent to some chance defect, we reproduce from the records the strain and section sheet of the bridge as filed with

the State Railroad Commission at Albany, from which it would appear (if there be no error in the strain-sheet, which we have not checked over but assume to be correct) that the bridge should have stood up, but had no very enormous margin. As we have often said before, we do not believe in the use of pin-connections for bridges of as short spans as this, for the reason that they furnish the elements of their own destruction in the small proportion of dead load to live load. An eye-witness, who has often examined this bridge under strain, informs us that it vibrated excessively, as do so many of these short-span, pin-connected bridges. If they were provided with a buckle-plate and ballast floor, like that which we also illustrate this week, they would have a far better chance of life, and the chief objection to them would disappear; but in any case, the pin connection is plainly not true economy for spans of 100 ft. or less.

The Practical Calculation of the Heads, Diameters, and Discharges of Long Pipes.

BY E. SHERMAN GOULD.

(Concluded from page 234.)

In all the previous examples, the coefficients for rough pipes have been used. It is well to remember that, as is shown by (15) and (16), the discharge of a clean pipe of given diameter is about 40 per cent. greater than that of a rough pipe of the same diameter, also that the diameter of a clean pipe discharging an equal volume with a rough one, will be about 88 per cent. of the latter. Between these limits of smoothness and roughness, there are, of course, an indefinite number of gradations.

A very interesting investigation is that of a system of pipes communicating with two reservoirs, and discharging either freely in the air, or into a third reservoir situated at a lower elevation, as shown in Fig. 10.

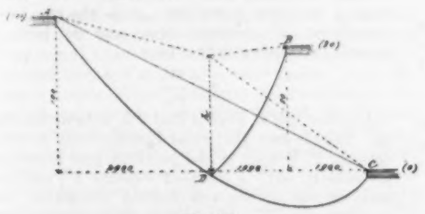


Fig. 10.

Let us suppose the water surfaces in A and B to be respectively 100 and 80 ft. above the water surface in C, and that all the pipes shown in the figure are 12 ins. in diameter. Let the total length of pipe from A to C be 4,000 ft.

If communication were shut off from B, the flow would be direct from A to C; if communication were shut off from C, it would be direct from A to B. If A were shut off, the flow would be from B to C. If all the communications were wide open, we desire to know whether the flow will be from A to B and C, or from A and B to C; and in either case, to know the piezometric head h, at the junction D, and the volumes discharged.

First, let the junction D be situated midway in the 4,000-ft. pipe joining A and C, and let the length $B\,D$ be 1,000 ft. Let us for a moment revert to the supposition that B is shut off. The flow would then be from A to C, the hydraulic grade line would be a straight line joining the surfaces A and C, and under our present hypothesis that the junction D is in the middle of $A\,C$, the piezometric head would be 50 ft. above the surface of the lower reservoir C. But B is supposed to be 80 ft. above the same, and therefore the flow must be from A and B to C. We might at first sight suppose that the flow from B to C would be in virtue of the head $80 - 50 = 30$ ft., which is the difference of level between B and the piezometric head at the junction; but just as a branch drawing water *from* a main pipe lowers the piezometric head at the junction, so does a branch discharging *into* the main pipe, raise it. It is necessary to see what the height h will be in the present case.

The quantity discharged into C is equal to the sum of the quantities passing from A and B. All areas and co-efficients being equal, and all reductions made, we have:

$$\sqrt{\frac{h}{2}} = \sqrt{50 - \frac{h}{2}} + \sqrt{80 - h}$$

whence

$$h = 65 + \sqrt{4{,}000 - 90\,h + \frac{h^2}{2}}$$

and, by successive approximations:

$$h = 74$$

Using this value of h in (3), we obtain the different discharges, as follows:

$$Q = 5.88$$
$$Q' = 3.48$$
$$Q'' = 2.37$$

This gives a very close agreement in the relation $Q = Q' + Q''$.

Suppose now that the diameter of the branch $B\,D$ be reduced to 6 ins. all the other conditions remaining the same. Still regarding the co-efficients as equal, in order to get rapidly at an approximation, factoring the areas and simplifying, we have:

$$\sqrt[4]{\frac{h}{2}} = \sqrt[4]{50 - \frac{h}{2}} + \sqrt[4]{40 - \frac{h}{2}}$$

whence:

$$16.5\,h = 840 + 4\sqrt{8{,}000 - 180\,h + h^2}$$

and, by successive approximations:

$$h = 58$$

This value of h gives the following quantities:

$$Q = 5.21$$
$$Q' = 4.43$$
$$Q'' = 1.08$$

A tolerably close check, but showing that the true value of h is a little greater than the even 58 ft. at which we have placed it.

Let us now suppose that the pipe $B\,D$ is increased to a diameter of 36 ins. all the other conditions remaining as before.

Then:

$$\sqrt{\frac{h}{2}} = \sqrt{50 - \frac{h}{2}} + 9\sqrt{80 - h}$$

Whence:

$$h = 79.90$$

Giving

$$Q = 6.111$$
$$Q' = 3.065$$
$$Q'' = 2.816$$

a close approximation; the true value of h lies between 79.85 and 79.90.

As h increases with the diameter of the pipe $B\,D$, it might at first seem as though, by indefinitely increasing the diameter, h might be so increased as to cause a flow from A into B. A moment's reflection, however, will show that under the assumed conditions, the diameter can never be sufficiently increased to cause a flow towards B. For it has been seen that when B is shut off, the piezometric head at D is 50 ft. It is raised by opening the communication with B, and allowing water to flow into the main from B. It is evidently, therefore, an essential condition of the increase of piezometric height that the flow should be from, not to, the reservoir B.

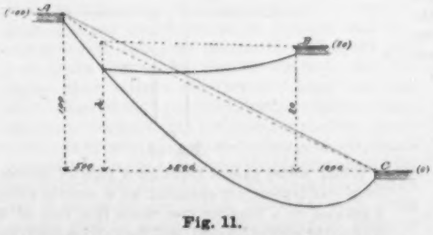


Fig. 11.

But the effect will be different if the junction D be sufficiently advanced towards the reservoir A. Let us suppose the positions of the three reservoirs to remain the same, all the pipe diameters to be 12 ins., and the point of junction of the pipe $B\,D$ to be placed at 500 ft. from A (Fig. 11). If communication with B were shut off, the piezometric height at D would be 87.5 ft. There would therefore be a flow from A to B and C when the pipe leading to B was open. But this flow would not take place under the head 87.5, for the draught towards B would lower it.

To ascertain the true value of h at the point D, we have the relation:

$$\sqrt{\frac{100 - h}{500}} = \sqrt{\frac{h}{3{,}500}} + \sqrt{\frac{h - 80}{2{,}500}}$$

simplifying:

$$\sqrt{100 - h} = \sqrt{\frac{h}{7}} + \sqrt{\frac{h - 80}{5}}$$

$$47\,h = 4000 - 11.86\sqrt{h^2 - 80\,h}$$

whence:

$$h = 82.65$$

Using this value of h we get:

$$Q = 5.695$$
$$Q' = 4.698$$
$$Q'' = .995$$

When B is shut off, in the above system, the discharge from A to C is 4.83 cu. ft. per second.

In all that precedes, only the resistance due to friction has been considered, and the total difference of level between the source of supply and the discharge has been taken as available for overcoming this frictional resistance. In the case of long pipes, where the velocity is comparatively low, this resistance is so greatly in excess of all the others that, in order to simplify calculations, they are neglected. This leads to no material error in cases where the pipe is over 1,000 diameters in length.

Attention, however, has been already called to the fact that there are other resistances which require a certain proportion of the total head to overcome them, leaving only the remainder available as against friction. Indeed, it is evident that if we assume all the head to be consumed by frictional resistance alone, the water in the pipe would be in exact equilibrium, and no flow could take place.

It will now be proper to show how the total loss of head, from all causes, may be calculated. And first, a word in reference to the phrase "loss of head" just employed. This term, often met with in treatises on hydraulics, may occasionally prove confusing. It is really little more than a convenient abreviation. When we speak, for instance, of "the loss of head due to velocity," we mean the head, or fall, theoretically necessary to produce that velocity. Similarly, when we speak of "the loss of head due to resistance to entry," we mean the amount of head, or pressure, necessary to force the fluid vein into the mouth of the pipe or orifice, against the resistance of its edges. This resistance, it may be remarked in passing, as well as that due to bends, elbows, and branches, shortly to be mentioned, is caused by the fact that water is not a perfect fluid, and therefore changes of direction in its flow require a certain amount of force to break or distort the form of the fluid vein, as, though to a very much less degree, would be the case with a plastic body under similar circumstances. The property of water which causes these resistances is called its *viscosity*.

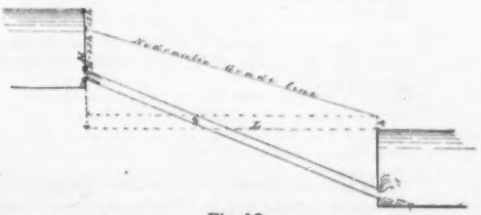


Fig. 12.

As applied to long pipes, the principal "loss of head," and the only one hitherto considered, is the *frictional*. The term thus applied means the height or pressure necessary to overcome the friction of the water passing with a given velocity through a pipe of given diameter. Thus, when we speak of the frictional loss of head per 1,000 ft. in reference to a given pipe, we mean the fall per 1,000 ft. necessary to maintain the given or desired velocity, as against friction.

We will now investigate this subject by means of the following problem: Two reservoirs (Fig. 12) containing still water and having a difference of level of 30 ft., are joined by a pipe 12 ins. in diameter and 3,000 ft. long. What is the velocity of discharge between the upper and lower reservoirs?

From what has been already said, it will be seen that besides the frictional loss of head, there will be the loss of head due to velocity, and that due to entrance. If the pipe discharged freely in the air at

ERRATA.—In the last issue, March 16, in the first two equations at the foot of the middle column of page 233, the factors C and C' should be canceled in both numerator and denominator, as the diameters are supposed to be constant. In the third equation C' in the numerator, and in the last equation C' in the denominator, should have been printed C.

In the table of 5th powers on page 234, the powers 4.14 and 7.595 should have been printed respectively 4.214 and 7.594.

its lower end, at the vertical distance of 30 ft. below the surface of the water in the upper reservoir, these three would be the only losses of head incurred, and their sum would be equal to 30 ft.; but as the discharge takes place in a reservoir, the surface of the water in which is supposed to cover the end of the pipe, to a sufficient depth to cause the discharge to take place in still water, there is the further loss of head due to the *extinction of the velocity*, which is dissipated in vortices. This loss constituted what may be called the *back pressure* of the reservoir.

In solving this problem, let us first, as heretofore, neglect all losses except frictional ones. We have then, from (1), using the above data, and the coefficient for rough pipes:

$$\frac{1}{100} = 0.00066\ V^2$$
$$V^2 = 15.15$$
$$V = 3.89 \text{ ft. per second.}$$

The head theoretically necessary to produce this velocity is given by the formula derived from the law of falling bodies, $h = \frac{V^2}{2g}$, by substitution of the above value V^2. Thus:

$$h = \frac{15.15}{64.4}$$
$$h = 0.2352$$

Besides this, there is the loss of head due to entrance. We have already seen that this is always equal to about half the velocity head. We have then:

$$h + \frac{h}{2} = 0.3528$$

The loss of head from back pressure of the water in the lower reservoir, being that necessary to extinguish the velocity, must be equal to that necessary to produce the same. We have therefore for the total losses, outside of friction:

$$h + \frac{h}{2} + h = 0.588$$

And the head available for overcoming friction becomes:

$$30 - 0.588 = 29.412$$

We must now recast our original calculation, using 29.4 ft. instead of 30, as available frictional head. Thus:

$$\frac{29.4}{3000} = 0.00066\ V^2$$
$$V^2 = 14.8$$
$$V = 3.85$$

This is a very small reduction from the velocity already obtained. But, in order to see how our previous solution is affected by the change, we will work out new values for the sub-heads. Thus:

$$h = \frac{14.8}{64.4}$$
$$h = 0.23$$
$$h + \frac{h}{2} + h = 0.575$$
$$30 - 0.575 = 29.425$$

leaving the previous value practically unchanged.

Let us now see, by means of a general formula, what is the amount of error which we commit when we ignore all resistances except friction.

Calling V the actual mean velocity, that is the actual volume discharged divided by the area of the pipe (3), we have, in the case of discharge between two reservoirs, as shown in Fig. 12, the following sub-heads, which together make up the total head H:

$$H = \frac{V^2}{2g} + \frac{V^2}{4g} + \frac{V^2}{2g} + \frac{L\,C\,V^2}{D}$$
$$H = \frac{5V^2}{4g} + \frac{L\,C\,V^2}{D}$$
$$H = 0.039\ V^2 + \frac{L\,C\,V^2}{D}$$

That is to say, by using (3) which gives:

$$H = \frac{L\,C\,V^2}{D}$$

we make the error of omitting to deduct a distance not quite equal to 4 per cent. of the square of the velocity.

In long pipes this is a very trifling amount.

If the pipe discharged in free air, we would have:

$$H = \frac{V^2}{2g} + \frac{V^2}{4g} + \frac{L\,C\,V^2}{D}$$
$$H = 0.0233\ V^2 + \frac{L\,C\,V^2}{D}$$

In this case we make the still smaller error of omitting to deduct not quite 2½ per cent. of V^2.

In all cases, having obtained V^2 by means of (1), we can easily judge from the nature of the problem whether it is necessary to take account of these errors. In designing a system of pipes, where the problem generally is to find the proper diameter for a certain discharge, the practice of taking the next highest even inch will almost always amply suffice to cover all omissions.

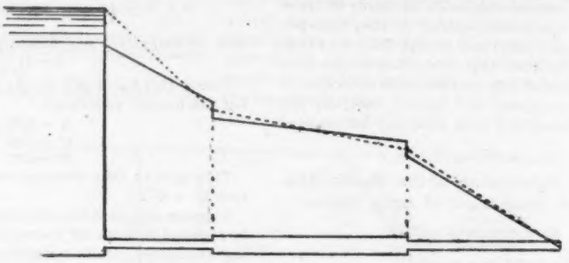


Fig. 15

As has been already stated, in all ordinary circumstances of pipe laying, the horizontal measurement of the pipe is taken instead of its actual length. It is only in special cases that this cannot be done. The extreme limit occurs in the case of a vertical pipe discharging from the bottom of a reservoir. This constitutes a very interesting special case, for should the reservoir be of indefinitely large area, but of relatively shallow depth, the relation $\frac{H}{L}$ tends towards unity as L, and consequently H increases. The velocity, as determined by (1) tends therefore toward:

$$V = \sqrt{\frac{D}{C}}$$

and remains constant, no matter how greatly L may be increased. If we apply this formula to a 12-in. pipe of indefinite length, using the coefficient for rough pipes, we get:

$$V = 38.9$$

This is the maximum velocity of discharge in feet per second for a vertical 12-in. pipe under the given circumstances.

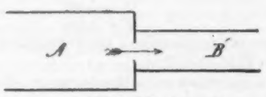


Fig. 13.

There are several minor losses of head, besides those already considered, which are liable to occur from changes of diameter, branches, and bends or elbows. Our experimental knowledge of the effects of these features is very limited, and it is probable that much weight should not be attached to the formulæ given for their determination. A brief space will be devoted to their consideration, more with a view to make the present paper complete than for any practical value which they possess.

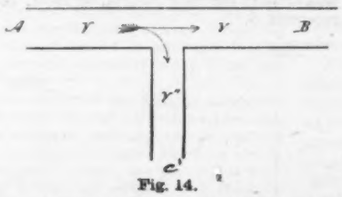


Fig. 14.

When water passes through a pipe of which the diameter is abruptly changed, at a certain point, to a greater or a smaller one, there is a loss of head due to the eddies formed and the sudden contraction of the fluid vein. In practice such pipes are always joined by a *reducer*, or special casting, which forms a tapering connection between the two. This greatly diminishes the agitation of the water in passing from one pipe to the other. It would seem, however, that the mere change of velocity, independent of such agitation, causes some slight modification of the profile of the hydraulic grade line; and it will be well, in any event, to give formulæ for the different cases which may occur when abrupt changes take place, as these give rise to the maximum retardation. The following formulæ are taken from Claudel's *Aide Mémoire*, ninth edition.

First.—When the change is from one pipe to another of smaller diameter, we have:

$$h = 0.49\ \frac{V^2}{2g}$$

whence:

$$h = 0.00076\ V^2$$

V being the velocity of the water in the smaller pipe. We have seen, by examples previously given, how this velocity may be obtained.

Second.—If the water (Fig. 13), in its passage from the greater to the smaller pipe, passes through an opening in a thin diaphragm, as in the case of a partially opened stop-cock, we have:

$$h = \frac{V^2}{2g} \cdot \left(\frac{S}{0.62\,S'} - 1\right)^2$$

in which V is the velocity in B, S the area of cross-section of B, and S', the area of the opening in the diaphragm.

Third.—When the flow is from one pipe to another of larger diameter:

$$h = \frac{(V - V')^2}{2g}$$

in which V = velocity in small pipe, and V' = velocity in larger one. When the water passes from a pipe into a reservoir, as in the case lately considered, V' becomes zero, and we have, as already established in that case:

$$h = \frac{V^2}{2g}$$

Another loss of head is that due to branches (Fig. 14). In this case the water flowing from A with a velocity V, is split at the junction, part passing on towards B, with a reduced velocity V', and part entering the branch and flowing towards C, with the velocity V''. The loss of head occasioned by perturbations of the water at the junction has not been satisfactorily investigated. When the branch leaves the main at a right angle, this loss, as determined by a few incomplete experiments, is:

$$h = \frac{3\ V''^2}{2g}$$

V'' being the velocity in the branch. We have already seen how this velocity may be calculated.

If, as is generally the case in practice, the branch is deflected gradually instead of forming an abrupt angle of 90°, the vortices are nearly annulled, and the only loss can be from the difference of the velocities in the three pipes. Thus for B and C respectively, we have:

$$h = \left(\frac{V - V'}{2g}\right)^2$$
$$h' = \left(\frac{V - V''}{2g}\right)$$

For bends, or elbows, Navier's formula for loss of head is:

$$h = \frac{V^2}{2g}\left(0.0128 + 0.0186\,R\right)\frac{A}{R^2}$$

in which V = velocity of flow, R = the radius of the bend, taken along the axis of the pipe, and A = the length of the bend, also measured along the axis.

It will readily be seen how very trifling the loss of head from this cause will be in all ordinary cases.

The water passing around a bend exercises a radial thrust upon it which may sometimes be so considerable as to require bracing against. The expression for the centrifugal force F is:

$$F = \frac{M\,V^2}{R}$$

in which M = the mass of the liquid in motion, V = its velocity, and R = the radius of the bend measured on its axis.

As an illustration, we will suppose a pipe 24 ins.

in diameter, through which the water flows with the velocity of 8 ft. per second, around a bend of 8 ft. radius.

The mass of the liquid in motion is its weight divided by g. The centrifugal force, therefore, per running foot is:

$$F = \frac{3.14 \times 62.5}{32.2} \times \frac{8^2}{8}$$

$$F = 48.72 \text{ lbs.}$$

If the bend turns a quarter circumference, its development on the axis will be 12.57 ft., and the total thrust on the bend will be $48.72 \times 12.57 = 612.4$ lbs.

This would be liable to be intensified by sudden changes in velocity, and if the bend is not well abutted, might tend to draw the joints.

Fig. 15 shows the manner in which such losses of head as we have been just considering, modify the profile of the hydraulic grade line. The dotted line shows the grade as determined by the calculations which we have already made for a line of pipes of varying diameter. The full line, broken at the reservoir and at each change of diameter, shows the hydraulic grade as modified by losses of head due to velocity and changes of diameter. It will be understood, of course, that this is a mere random sketch, without reference to proportion.

The result of what precedes in reference to all losses of head other than friction, shows that in practice, and in the case of long pipes, such losses exercise but a trifling influence. A very small increase in the diameter of the pipe over that obtained by calculation based on frictional head alone, such as would naturally be made to get even inches, will in almost all cases largely cover all losses due to velocity, entrances, branches, bends, etc.

Proportion of Rainfall reaching the Sewers.

BY EMIL KUICHLING, M. AM. SOC. C. E.

(*Continued from page 233.*)

In German cities, the recent practice appears to be similar in general theory to that just outlined for French towns, only that the maximum rainfall is usually taken at a much lower figure. Thus, for Berlin, such rainfall is assumed at only seven-eighths of an inch per hour, one-third thereof reaching the sewers while the rain is falling. The mean annual rainfall is, however, only 22.3 ins., and it is claimed that a greater intensity than about 1.0 inch per hour was never observed there. Under such conditions a liberal provision appears to have been made. For Vienna, the maximum rainfall was assumed at about 1.10 inches per hour, and three-eighths thereof is considered to reach the sewers in the same time. For Frankfort, Munich, Stuttgart, and a number of other cities, variable allowances were made by the designers of the sewerage systems, but in all cases relief was assured by a sufficient number of storm-overflows into the rivers. It is, however, quite noticeable from the more recent reports and works on sewerage, that higher intensities of rainfall than heretofore considered admissible must be adopted for urban districts in which storm-outlets are impracticable. For example, when the sewerage of Stuttgart was designed in 1874, it was assumed that not more than 27.5 per cent. of any rainfall would reach the main intercepting sewer during the continuance of the storm; but the City Engineer, in a work published in 1886, states that such an assumption is justifiable only when the drainage area includes large tracts of vacant land, and that his experience indicates a proportion ranging from 50 to 70 per cent. of the rainfall, according to the density of population and the condition of the street pavements. In his report on the sewerage of Königsberg, in 1883, the distinguished engineer Wiebe recommends that provision be made for admitting 50 per cent. of a maximum observed rainfall of 2.89 inches per hour into all sewers in the high-level districts of the city, where no storm-overflows could be obtained; he also considers that very little of the water runs off from moderately inclined gardens, lawns, and vacant land into the sewers during the first hour of the storm, and hence that only the area actually covered with buildings and pavements need be considered; for the city mentioned, he estimates this relatively impervious area at from 42.3 to 54.0 per cent. of the total drainage area, according to the particular districts considered. To compensate for any contributions from the garden and land surface thus omitted, the roof and pavement surface is regarded as fully impervious, and taking this latter on an average at 50 per cent. of the whole, with one-half of the rainfall running off, it will be seen that by this procedure provision for about one-fourth of the maximum rate of precipitation is made in the sewers. For Mayence, the elaborate report of City Engineer Kreyssig, published in 1879, contained similar statements to the effect that all sewers not provided with storm-outlets should be capable of removing the accumulated surface drainage due to the heaviest observed storms without becoming surcharged; and as the rainfall records of that city indicated that the depth yielded by an extraordinary rain, such as occurs only once every few years, is about 1.60 inches per hour, Kreyssig considered this limit as the lowest which could reasonably be adopted for said locality, and that at least 50 per cent. of such a fall would reach the sewers within one hour from the old and more densely populated districts. With respect to the general character of the surface in European cities, it may be remarked here that the local density of population in the older districts is often very great, the average being about 291 people per acre in Stuttgart and 162 in Mayence; furthermore, that every street is well paved, and that very little of the surface is occupied by gardens or lawns, so that an estimate of only 50 per cent. of the rainfall is by no means large.

On the other hand, in support of the common theory of English engineers that heavy rainfalls of comparatively short duration do not yield such large percentages of discharge from urban surfaces, City Engineer Mank of Dresden published in the "Deutsche Bauzeitung" for 1884 the following observation. During a rain which lasted 25 minutes and fell at the rate of 1.96 ins. per hour, the outlet sewer of a certain district of 326.7 acres in Dresden was noticed to be running completely full; the said district contained 49.1 acres of surface in the old portion of the city, which was almost entirely covered with roofs and pavements, 164.2 acres of closely built-up territory in the new portion, and 113.4 acres of semi-suburban surface. Considering the first-named component area as fully impervious, the second as giving 67 per cent. of impervious surface, and the third as giving only 34 per cent. of such surface, we would have an aggregate of 197.7 acres, or 60 per cent. of the whole, as practically impervious, and from which all of the rainfall should be delivered rapidly into the sewers. At the said rate of 1.96 ins. per hour, the water fell on said 127.7 acres at the rate of 387.5 cubic ft. per second, while the outlet sewer was alleged to be discharging only 83.9 cubic ft. per second; and hence it was inferred that a rain of the great intensity mentioned could yield to the sewers only about 21.7 per cent. of the precipitation on the estimated impervious surface, or only 13.1 per cent. of that on the total area. Exception to the aforesaid estimate of impervious surface might readily be taken as being excessive, and the percentage of discharge might thus easily be increased; the rain may also have been of much less intensity on this particular drainage area than it was at the location of the gauge, since in storms of such great violence the observations of the writer prove conclusively that a difference of one-half or even one-fourth of a mile may make an enormous reduction of average intensity during so short a period as 25 minutes; the description given, furthermore, does not state specifically that the said discharge was the absolute maximum during the progress of the shower, and that the water did not rise higher than stated either before or after the time of the observation; but the principal exception that the writer makes to the foregoing is that the measurements of maximum flood-discharge by automatic gauges in a number of sewers in this city during the past year firmly establish the fact that the percentage of discharge for such a shower is very much greater than as computed above; and in proof of the validity of this assertion, the following instance may here be cited.

Between 7.25 P. M. and 8.00 P. M. on May 9, 1888, a violent thunder-storm, giving 0.767 ins. of rain in 35 minutes, or a rate of 1.315 ins. per hour, passed over the city from southwest to northeast; the writer had an opportunity to see the approach of the cloud from an elevated position, and to notice that one of his rain-gauges lay directly in the track of the densest rain, while the other was near the edge of the shower. The latter yielded a depth of only 0.203 ins., and hence a rate of 0.348 ins. per hour, its distance from the former being about two miles. Now the maximum discharge of the Clifford St. and Avenue B outlet-sewer, whose drainage area was seen to be traversed by the heavest portion of this rain, was found to be 73.3 cu. ft. per second from a total tributary area of 356.9 acres, in which the average density of population does not exceed 20 per acre, and in which there are only a very few macadamized roadways, all the rest of the streets having simply natural earth roadways, with graded gutters and plank sidewalks; the vacant land, moreover, is largely of a gravelly character, so that little was contributed therefrom to the sewers. About three-fourths of the said territory is well drained, nearly every street therein being provided with a sewer, while the remainder is to a great extent undeveloped agricultural land. The dwellings are principally small cottages, many of which are not yet connected with the sewer. According to Table K in a preceding paper, the aggregate impervious surface should be about 20 per cent. of the total area of 356.9 acres; but in view of the fact that the construction of said Table predicated much better conditions of surface than are actually presented on this territory, the percentage of impervious surface should be reduced to not more than 15, whence we would have about 53.6 acres of such surface from which all of the water would reach the sewer. On this basis, and with a rate of rainfall of 1.315 ins. per hour, the maximum sewer discharge should be 70.5 cu. ft. per second, which is a close agreement with the observed discharge of 73.3 cu. ft. To complete the data, it may be further remarked that the time required for the concentration of the surface drainage from the most distant points of the area to the point where the said maximum flow was registered is about 34 minutes, the average velocity of flow in the sewers being about 4.4 ft. per second when nearly full, and their grades ranging from 1 in 64 to 1 in 822, with an average of 1 in 150. The said storm thus lasted long enough to cause the whole area to contribute to the flood discharge, which yielded a maximum of 15.6 per cent. of the rainfall on a territory which may fairly be classed as rural in comparison with the above described district of nearly equal magnitude in Dresden. Under the circumstances, therefore, the writer is convinced that there must be some serious error in the aforesaid data relating to Dresden, from which a maximum discharge was deduced of only 13.1 per cent. of a storm having an intensity of 1.96 ins. per hour, lasting 25 minutes, and falling upon a well-sewered urban area of which 60 per cent. is regarded as impervious.

On the strength of these latter data, Mr. MANK built up a series of sewerage tables for the use of municipal engineers which have been extensively copied into recent reports, notably those relating to Berlin and Wiesbaden. The professional eminence of the authors of these two reports is such as to have added greatly to the value and reliability of these tables, and it is only after abundant proof from the results of his own carefully conducted gaugings was afforded, that the writer now ventures to call them in question. Their manifest error is attested by a number of other experiments similar to the one just described, and which will be given in detail in a following paper, also by the observations made in the past by English and American engineers. In view of these facts it is hardly worth while to consider further this method of computing the dimensions of outlets for districts of ordinary size.

The relation between the magnitude of a drainage area, the surface discharge, and the time required for the concentration of such discharge has long been recognized in a general way, but does not appear to have been very definitely expressed. In a paper by Gen. O'CONNELL on "The Flood Discharge of Rivers," published in Vol. 27 of Proc. Inst. C. E., the principle is stated as follows: "When water falls in the shape of rain on any solid surface whence it afterwards flows off, it forms its own drainage vehicle. It produces over that solid surface a certain depth of water with a certain superficial slope or fall toward an outlet; these two conditions, depth and surface slope, being necessary to produce flow. Should the solid surface be at all absorbent, the rain has to furnish the quantity of water necessary to saturate it. While the drainage vehicle is forming and having its capacity increased, the water is flowing off the surface less rapidly than it

falls upon it, and, should the rain cease before it has completed its own drainage vehicle, the rate of discharge from the surface upon which it falls will never equal the rate at which the rain has fallen upon it. It is only when the time necessary for this preliminary operation of forming its own drainage vehicle has elapsed, that the water flows off from a surface as rapidly as it falls upon it. The time required increases with the linear distance between the upper and lower ends of the surface drained, and with the gentleness of its fall." When the drainage area is small and has a comparatively impervious surface, the time necessary to establish equilibrium between precipitation and discharge, or to form what is termed "the drainage vehicle" in the foregoing, is relatively short; and as the distance that the rainfall has to travel over the surface before reaching some pipe or channel directly connected with the sewers is generally quite short in populous districts, it will be seen that maximum rates of rainfall corresponding to such short times must be considered in estimating the volume of storm-water instead of average rates deduced from relatively long periods of time, also that the time will diminish in some proportion as the amount of impervious surface on the area increases. The latter, however, may be regarded in the case of cities as directly proportional to the density of the population up to a certain limit, after which it remains substantially constant, and hence the necessity of ascertaining the probable relation between these two elements before undertaking to compute dimensions for sewers in cities which are not yet fully developed.

Several attempts have been made to express the general principles above set forth in mathematical terms, but without much success from a scientific standpoint. The eminent English engineer HAWKSLEY endeavored to find a relation between the diameter of a circular conduit or sewer, the magnitude of the drainage area, the general slope of the surface, which was assumed to be parallel to the inclination of the sewer, and a rainfall of one inch per hour, on the assumption that half of the water would be discharged by the sewer within one hour. After many trials he finally invented the famous empirical formula which bears his name and from which a few others have since been deduced. Foremost among the derivatives stands the expression proposed in 1880 by the distinguished Swiss engineer BURKLI ZIEGLER, but as it is merely Hawksley's formula in a somewhat different form, although admitting of a wider range of application by means of variable coefficients, it cannot be characterized as a great improvement over the original. With reference to Hawksley's formula, Col. J. W. ADAMS, C. E., of Brooklyn, in his excellent work on Sewerage remarks that "while it gives ample capacity for the smaller dimensions of sewers and for limited areas, it did not prove so satisfactory in the larger," and he accordingly proposes a different empirical expression, which, "while giving slightly less results in the smaller areas, gives the increased dimensions in the larger that experience has pointed out as desirable in this locality." The latest of such formulas is the one proposed by R. E. McMATH, C. E., of St. Louis, in the Transactions of the American Society of Civil Engineers for 1887; it is modeled after that of BURKLI-ZIEGLER, but with a different exponent, so that materially different results are obtained.

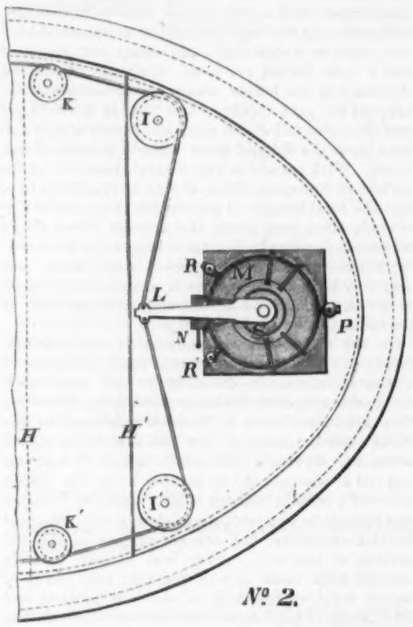
(TO BE CONTINUED.)

Hornig's Direct Power Steering System.

The direct power steering system here illustrated is the invention of Mr. JULIUS L. HORNIG, M. E., and is adapted to pneumatic, steam, or hydraulic power, though the pneumatic pressure is much preferred by the inventor for reasons to be given later. It was patented on Feb. 19, 1889.

As shown in Fig. 1, this motor is attached directly to the rudder-head, and occupies but little space as compared with steam steering apparatus in actual use. The principle involved is the employment of elastic fluid pressure, the variation of pressure alone on either side of the piston causing motion in the piston and in the rudder connected with it. The resulting advantage is a reliable, safe, economical and quick movement in steering.

The great advantage of air-pressure is that, while liquids may freeze and steam condense, air is not subject to such changes, and is also more elastic and thus preferable to liquids. Two United States naval boards investigated, in 1886, the principle of steering ships by compressed air, and reported its superiority in the trials made. In tests made it was shown that with pneumatic power the rudder would be put hard over in $2\frac{1}{5}$ seconds by one man with easy movement of a lever, while it took four men at the hand-gear $11\frac{1}{2}$ seconds to do the same thing under like conditions, or over five times as



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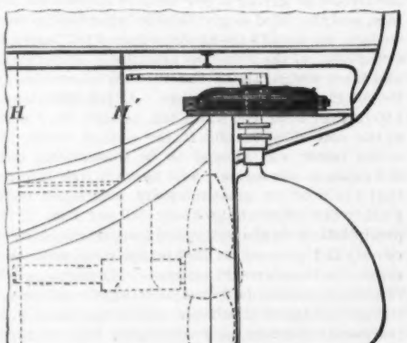


The Hornig Steering System.

long. On another occasion the time required for a similar application of power was 5 seconds for pneumatic power, 30 seconds for the usual steam-steerer, and 90 seconds for one man on the hand-wheel.

Unlike some other combinations of power and hand steering, this system admits of a simple and instantaneous change from one to the other, and it is applicable to every variety of vessel, from a tug to the largest steamship. The motor is constructed to carry 120 lbs. pressure, and can be placed over the rudder-head directly and situated near it, and act upon the tiller-arm or upon a segment fixed to the rudder-head connected by chain or rope.

In Fig. 1 M shows the motor over the rudder; L is the tiller; I I are the quarter-blocks; K K are leaders; R R are relief cocks; and P is a regulator cock for the brake. Fig. 2 is a triple piston motor with one brake chamber. In this figure A and C are the bottom and top cases; B the pistons; g the ports; H the valve-chest; I inlet pipe and K outlet pipe. M is a relief lever operating the regulator valve U; N is a lever for the main valve; S the shaft and T the hub.

Trial of a Tubular Boiler with Downward Draught Furnace.

A test was made of a new 100 H. P. steam boiler, Feb. 25, 1889, at the works of the Suffolk Cordage Co., Chelsea, Mass., by Mr. FRANCIS E. GALLOUPE, Mechanical Engineer, which gave remarkable economical results, and, as will be seen from the following report raises several interesting queries as to the relative advantages of burning coal by the old method of natural upward draught or by a draught in the reverse direction, and as to whether, by the comparatively new method of employing a downward draught, economical results not before attainable may not now be reached.

Boiler work and operation has not advanced to anything like the extent that other branches of mechanical engineering have during the last 20 years, although boiler capacity and efficiency is the antecedent condition and essential of the successful operation of all forms of steam plant as well as for modern electric appliances in lighting, welding, and power for motors and street railways; and it may well be asked if something cannot be done more than has been done to increase the capacity and improve the efficiency of the steam boiler. The following test seems at least to indicate some possibilities in this direction.

Briefly described, the boiler tested is an ordinary horizontal cylindrical multitubular boiler, not differing in either the general or detailed design or in the relative water and steam space, from that of the ordinary form, except in the furnace.

The furnace is built of steel plates, riveted like those of the shell, and is placed entirely within the shell of the boiler and surrounded by water spaces.

At the back end of the grate a hanging water-leg of steel plates, riveted to the crown sheet of the furnace, extends downwards to within 18 ins. of the ash-pit or furnace bottom.

The grate is formed of water-tubes entering the front side of the water-leg at the back end of the grate, at a moderate inclination from the horizontal. These tubes enter a gun metal box in front, just below the level of the furnace doors. Return tubes, also inclined, extend from this box beneath the grate tubes back to the water-leg, and ensure a circulation of water from the main shell and water-leg through the grate tubes.

The space beneath the grate, ordinarily the ash-pit, is the combustion chamber, and the air for combustion is admitted through the fire doors above the grate and drawn down by the chimney draught through the grate bars, where it becomes highly heated before or during its combination with the hot gases from the coal.

Beyond the water-leg, extending up to the crown-sheet of the furnace, is an extension of the combustion-chamber, which forms the passage to the tubes, the tube sheet being 10 ins. horizontally from the back of the water-leg. The hot gases pass from this point through the tubes, which form a large absorbing area, directly to the uptake and chimney.

The position and arrangement of the furnace resembles that in the locomotive boiler, with the addition of a deflecting arch which tends to mix the hot gases on their way to the tubes; and, as would be expected from this construction of an internal furnace entirely surrounded by the water-heating surfaces of the boiler, the boiler made steam very quickly and almost immediately on lighting the fire.

During the trial a Brown engine developing about 210 H. P. was run by the steam from the boiler under test in connection with one other boiler of usual form, and although all the machinery of these extensive works, including about 35 H. P. used in running generators for electric lights, was thrown on the engine, no difficulty was found in holding the steam pressure required, with the flue damper one-third open and fire-doors closed or placed ajar for a considerable portion of the time. Three of the ordinary boilers had previously been required to do this work.

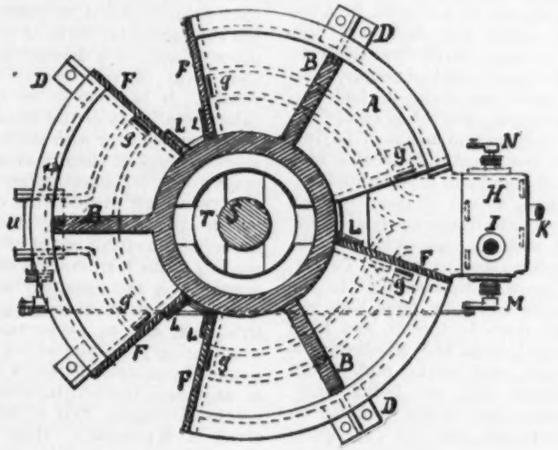
The boiler showed considerable reserve capacity for an increase of power whenever a demand was made upon it.

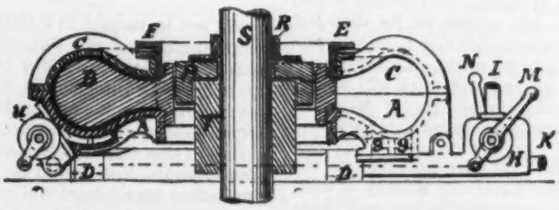
In the matter of safety, it would seem that this construction is safer than the ordinary form. The crown-sheet over the furnace has usually the least depth of water over it of any plate in a boiler ex-

posed to the action of the fire, and is at the same time exposed to the fiercest heat of the fire. The result of low water, should the crown-sheet not be covered, would be, in the ordinary case, to burn the plate, with a resulting bulging of the sheet or perhaps explosion of the boiler. In this boiler the hottest temperature of the fire is *beneath* the grate where all the surrounding surfaces are protected by water, which instantaneously absorbs the heat coming in contact with them, while, the direction of the draught being downward, and away from the crown-sheet, and the latter being still further cooled by the entering air used for combustion, the crown-sheet is kept comparatively cool, with in any case little probability of burning.

Should the water level be lowered below the grate, the grate tubes would burn off and destroy the fire.

An important advantage in supplying the air above the grate is that it is never necessary to open the combustion chamber to the outside air, which





Hornig Steering System; Triple-piston Motor.

cools the entire boiler, and causes loss of heat in the ordinary boiler whenever the furnace is fired. Throughout the test the ash-pit doors were kept closed.

The boiler was covered with asbestos, brick setting being unnecessary on account of the use of the internal furnace.

Since the radiation from the steam and water surfaces of the boiler was reduced by the covering to a minimum, the only losses of heat that could occur were either (1), by not supplying air in the right quantity or manner to consume the coal perfectly; (2), by admitting too great a quantity of air, the excess of which would be heated and wasted; or (3), by too strong a draught in the flue to the chimney, which would take off the hot gases before there was time for the absorption of their heat by the boiler. At the beginning of the test the flue damper was open and the temperature in the uptake was 590° Fahr. On closing the damper to about one-third opening, at which point it was kept during the remainder of the trial, temperatures varying from 330° to 375° Fahr. were obtained. At the steam pressure carried, the temperature of the steam and water in the boiler was about 330° Fahr. showing that the loss of heat above this temperature through the chimney was very small, varying from nothing (a very suspicious result) to at no time more than about 40° Fahr.

The firing was skilfully managed, and, so far as could be determined, no unnecessary amount of air was admitted. The percentage of refuse to the coal burned (9.91) shows that the coal, which was the best dry Cumberland to be had, was quite perfectly consumed.

From the above considerations and conditions, it might be expected that this boiler, properly run, would give high economical results. These were, as stated in detail below, an evaporation from an average temperature of 53½° Fahr. into steam of an average gauge pressure of 80 lbs., of 9.82 lbs. of water per pound of coal. The equivalent evaporation, reduced to the standard of "from and at 212° Fahr.," was 11.78 lbs. and per pound of combustible, 13.08 lbs.

The average result of a large number of tests made with different boilers at the Centennial Exhibition of 1876, which may still be taken as a standard for comparison, was 10.99 lbs. of water per pound of combustible. The performance of this boiler with this coal is therefore 19 per cent. more than the above average result, and this result cannot but be regarded as extremely satisfactory.

The boiler shows, as below, good proportions, and the conditions of setting, draught of chimney, etc., were favorable.

The steam, so far as could be judged, was of excellent quality, free from moisture, and there was no priming. Unfortunately, no arrangements were made in advance for determining quantitatively the percentage of entrained water in the steam, without which, it is admitted, the very high evaporative efficiency shown must naturally rest under a certain suspicion. This defect will probably be eliminated later, but in the mean time it can only be said that all the conditions were favorable to the production of very dry steam, and there is every reason to believe that it was almost wholly free from entrained water, as the other facts of the tests, as noted, may be fairly said to indirectly prove, since the insignificant wastage of heat necessitated about as high evaporative efficiency as is actually shown.

The coal was weighed and charged as dry coal, no deduction being made for moisture. The water consumption was accurately obtained by weighing all the water fed to the boiler, and there was no leakage. The water level in the boiler was the same at beginning and end of test, and the steam pressure made uniform at both times.

DATA.

Date of trial, Chelsea, Mass., Feb. 25, 1889.
Duration of trial, 10 hours 15 min.
Weather, clear; barometer 30.08; thermometer, 17; wind, direction N. W., velocity 10 miles per hour.

DIMENSIONS AND PROPORTIONS.

Boiler, horizontal tubular, with water-leg, internal furnace and downward draught. Condition, new and clean. Diameter of shell 6 ft. 6 ins.; length over all 15 ft. 9 ins.

Tubes, number 205, diameter, 3 ins. outside, length 7 ft.,

Furnace, width, 5 ft. 11 ins.; length, 4 ft. 8 ins.

Grate, 5 ft. 11 ins. wide by 4 ft. 8 ins. long, area 27.6 sq. ft.

1¼ in. tubes, number 31, length (over box) 4 ft. 8 ins., entering gun-metal box at front, 3 ins. wide; inclination, 1 in. to 1 ft.

Underneath connecting pipes 2 in. diameter, number 13, inclination 1½ in. to 1 ft.

Air-space through grate 10.62 sq. ft. = 38.46 per cent.

Area in throat to tube chamber, 5.3 sq. ft.; through tubes, 10 sq. ft. Uptake to chimney flue, 1 ft. 6 ins. x 6 ft., area, 9 sq. ft. Chimney, brick, height above grate 125 ft.; size 4 ft. 6 ins. Square inside, area, 20.25 sq. ft. Uptake flue enters chimney 12 ft. above grate. Chimney connected with three other boilers, 5 ft. shell x 17 ft. long.

Heating surface in grate	101	sq. ft.
" " " furnace	179	" "
" " " tubes	1,127	" "
" " " total	1,407	" "
Sq. ft. heat'g. surface per sq. ft. grate area	50	" "

RESULTS.

Steam pressure by gauge, average	80	lbs.
Temperatures, boiler room	66°	Fah.
" outside	20.6°	"
" feed water,	53.5°	"

FUEL.

Weight of kindling wood	165	lbs.
" " (at 0.4 coal)	66	"
Coal	3,422	"
Total equivalent amount coal consumed	3,488	"
Total refuse	339	"
" percentage of refuse	9.91	"
" combustible consumed	3,149	"
Dry coal consumed per hour	340	"
" " " per sq. ft. grate per hour	12.32	"

WATER.

Weight actually fed and evaporated	34,283	"

ECONOMIC EVAPORATION.

Water per lb. dry coal from actual pressure and temperature of feed	9.82	"
Equivalent evaporation per lb. dry coal from and at 212° Fahr	11.78	"
Equivalent evaporation per lb. combustible from and at 212° Fahr.	13.08	"

COMMERCIAL EVAPORATION.

Equivalent water evaporated per lb. of dry coal with one-sixth refuse, at 70 lbs. gauge pressure, from 100° temperature	9.48	"

RATE OF EVAPORATION.

Water evaporated from and at 212° Fahr. per sq. ft. heating surface per hour	3.14	"

COMMERCIAL HORSE-POWER.

At 30 lb. water evaporation from 100° Fahr. into steam at 70 lbs. gauge pressure	116.23	"
Horse power, builders' rating	100	"
Per cent. developed above rating	16.23	"

From any point of view, this is a most excellent and interesting test.

THE FAST RUNS BETWEEN LONDON AND SCOTLAND were commented on by the president of the Great Northern Ry. Co., at a recent meeting as follows:

In reference to the locomotive department, perhaps you may have observed lately some sensational paragraphs in some of the newspapers about what is called the race to Scotland. I have one before me here; it begins:

"The Great Northern and the North-Eastern railway companies are making vigorous preparations for the renewal of the race to Scotland in the ensuing summer. Huge engines are being built with single driving wheels of a large diameter. The Great Northern are not content with watering their tenders, but are sinking troughs between the rails, so that the engines can take up the supply while running."

I can only say that this is the greatest nonsense it is possible to conceive. There is not a single word of foundation for it. We have now, I think, engines with single driving wheels of large diameter as good as can be constructed, and we have no intention of building anything better if we could. With respect to the water troughs, we have not laid down a single yard of water trough, nor do we think of doing so. We are now running that Scotch service between London and Edinburgh in 8½ hours, or rather that is the whole time allowed. The actual running time, deducting the stoppages, is 7 hours 55 minutes I am inclined to think that most people consider that is quite fast enough. Well, I hope our friends on the West coast will be of the same opinion, but if they accelerate, we are bound to do the same thing. Last year we ran from London to Edinburgh in 7¼ hours, which meant for actual time 6 hours 55 minutes. That, gentlemen, is nearly at the average rate of one mile a minute. I am inclined to think that the public considers that a trifle too fast, and I think that railway companies are not justified in running at such speeds. I may as well add to what I have stated with respect to the east coast in this matter, that I have the authority of the North-Eastern company to say that they fully agree in the expressions that I have made use of.

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GEO. H. FROST. - - - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Regular meeting, April 1. "The Nature of Pollution with Reference to Sewerage," Kenneth Allen. Secy., Kenneth Allen, 310 Baird Building.

American Society of Civil Engineers, New York.—Regular meeting, April 3. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting April 3. "The Boiler for use at Coal Mines," Louis Stockett; "Steam Plants for Electrical Service," W. H. Bryan. Secy., Wm. H. Bryan, 709 Market St.

Western Society of Engineers, Chicago, Ill.—Regular meeting, April 3. Secy., John W. Weston, Gaff Building.

Engineers' Club, Philadelphia, Pa.—Regular meeting, April 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland, O.—Regular meeting April 9. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, .—Regular meeting, April 10. Boston & Albany passenger station.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, April 16. Secy., S. M. Wickersham, Penn Bldg.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, April 17. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, April 18. Rooms, 113 Liberty St., New York City.

Association of North American Railroad Superintendents.—Spring meeting Apr. 18, at 46 Bond St., New York City. Annual election of officers. C. A. Hammond, Sec., 350 Atlantic Ave., Boston, Mass.

WE find that we have inadvertently done Mr. THOS. H. JOHNSON, Principal Assistant Engineer of the Pittsburg, Cincinnati & St. Louis Railway, a serious injustice by a carelessly penned sentence capable of a double interpretation conveying exactly the opposite idea from what it was intended to convey, and not only capable of it, but rather inviting it; that is to say, admitting more naturally of the interpretation which was *not* intended than of that which was intended.

Mr. JOHNSON sent us on Feb. 14 an article on "Column Formulæ" published on page 172 of our issue of Feb. 23, of the current volume, with the argument and general conclusions of which we entirely agree, regarding them in fact as so evident theoretically, and so well confirmed by experiments practically, that they may be now legitimately regarded as belonging in the category of "established facts," which no technical journal or society cares to be a medium for controverting. Accordingly we appended to his communication the following note:

> Most of the Engineering Societies have by-laws forbidding the publication of papers "controverting established facts." To our mind, Mr. JOHNSON'S general theory may properly be included under this head, and we cannot publish anything further on the subject, unless it shall contain matter to cause us to change our conviction."

The "head" under which Mr. JOHNSON'S general theory was classified in the mind of the writer was of "established facts," and not by any means of "controverting established facts," but we learn now for the first time that not only Mr. JOHNSON but several others have read the sentence in the latter sense, which now that our attention is called to it, we perceive is the more natural sense; so that the "general theory" which it was intended to especially to endorse, we were made by an unfortunately ambiguous sentence to appear to rudely to condemn.

THE advantages to a city of good drainage and proper sewerage are strikingly illustrated in the case of Memphis, Tenn. Less than ten years ago trade was at a standstill there, the population had shrunk 20 per cent. in a few years, and real estate had decreased one-half in value, all because the city was scourged by disease, and its panic-stricken people, looking upon the place as doomed, had surrendered the municipal charter to escape the burden of debts they had no means of paying. But about 1880 a few hopeful, far-seeing men took the matter in hand and inaugurated, under great difficulties, an era of improvement. First of all, a complete drainage system was constructed, and with its completion, health and prosperity commenced to return. To-day, the Memphis *Appeal* estimates that in the last twelve months $5,000,000 have been put into public works there by foreign and local investors, a bridge across the Mississippi is under construction, new banks, club buildings, a union depot, etc., are being built, the cotton receipts have about doubled on those of nine years ago, and the population has increased in nearly the same proportion—all because it was finally realized that to prosper, a city must first of all use those precautions against epidemics and disease which sanitary science has placed at its disposal, and render its surroundings as healthful and inviting as they can be made. This done, ordinary business energy and push will do the rest, as the present prosperity of Memphis proves. There, drainage saved a dying city.

WE are informed that such an index to the Proceedings of the American Society of Civil Engineers as we suggested in our last issue is being prepared and is almost completed. We do not know if the compiler, who is an industrious and energetic young civil engineer, is connected with the American Society of Civil Engineers; but if his index is as well and conscientiously done as other work of his would lead us to expect, there should be no difficulty in having it published by the Society for the benefit of its members generally.

IN this connection Prof. J. B. JOHNSON, of Washington University, calls our attention to the fact that the Index Notes published in the *Journal* of the Association of Engineering Societies contains a full index of the Proceedings of the American Society of Civil Engineers, with the exception of the contents of Vols. I and II. The Association has issued four annual summaries of nearly all current engineering literature since 1884, including the papers of the Am. Soc. C. E., making a total of 242 pages of Descriptive Index Notes. They can be obtained by sending 30 cts., for each volume, to Mr. H. G. PROUT, Secretary of the Association, 73 Broadway, N. Y. Each item has appended to it a short note, giving its scope, purpose, and also an estimate of its value. As Prof. JOHNSON says, a separate index of the Proceedings of the American Society should be made, but meanwhile our readers may be glad to know that nearly all the requisite data are embodied in the excellent Index Notes of the Association referred to above.

THE downward draught boiler test reported in another column is deserving, we think, of not a little consideration, as showing unusual efficiency in a small and simple type of boiler under conditions which would appear to favor durability and safety much more than the ordinary conditions in boilers of the same general type, which are particularly objectionable in this, that there is a fierce concentration of heat and evaporation on the crown-sheet much in excess of what exists anywhere else. The downward draught system tends to equalize and distribute this excess and to transfer the fiercest evaporation to where there is no possible danger of lack of water from neglect. The idea of such a downward draught is not, we believe, entirely new, but the particular form of it described in another column is a decided novelty, and from any point of view shows very gratifying results. It is much to be regretted that no calorimeter tests of the amount of entrained water carried over with the steam were made, since the lack of them leaves a certain legitimate room for questioning the accuracy of the very high evaporation efficiency shown, which approaches very closely the ultimate theoretical heating power of the fuel; but the records of the temperature of the gases in the uptake, and the practical absence of other sources of heat wastage, go far to supply this lack, and to prove that the apparent evaporation from and at 212° of 13.08 lbs. per pound of combustible was a real one; or that, in any case, the results must have been exceptionally good. Out of 102 recorded trials given in WEISBACH'S "Heat and Steam," we find only 9 giving fractionally higher results, and none appreciably higher, which indeed is hardly possible.

WE are in receipt of a letter from the resident engineer of the Vancouver water-works earnestly objecting to our implied charge of giving wrong information to the contractor for laying the pipe across Burrard Inlet, referred to in our editorial note of March 2. It is due to this engineer to state that no charge was intended that would in the slightest degree affect his professional or personal standing as an engineer; the most careful man might easily miss one or more boulders in sounding a channel nearly half-a-mile wide, with water 70 ft. deep and scoured by a current of 9 miles per hour. And when we made our remark, we had before us evidence tending to show that such boulders existed, and were not marked upon the chart. But as our correspondent now says that the pipe so successfully put down by Messrs. KEEFER and MCGILLIVRAY was laid on the original line, we must either assume that the soundings were unusually correct in regard to the bottom, or that the excellent plan adopted by them for partially floating the pipe made the presence of small boulders no practical obstacle. But in either case, we ought, in justice to our correspondent, state that the bulk of evidence now appears to be in his favor.

THOUGH railway building was commenced in Brazil as early as 1854, a lately published railway map of that section of South America shows that comparatively little progress has been made since then in affording easier communication between its chief cities. Brazil covers 3,200,000 sq. miles of territory, and yet possessed only 4,757 miles of railway in operation on May 1, 1887. But as 978 miles were then under construction, the present mileage may be assumed as nearly 6,000. As a con-

trast it may be remarked that the Argentine Republic, with 1,000,000 sq. miles of territory, and 3,500,000 as compared with over 12,000,000 inhabitants in Brazil, had on Jan. 1, 1887, 6,161 miles of operated railways. It is only fair to say, however, that the republic has great advantages over the empire in climate and railway building conditions, as well as in the average better character of its inhabitants. The Brazilian railways are usually short lines running in from the coast a few miles in each case. With the exception of the system radiating from Rio Janeiro as a center, these coast lines are totally independent of each other, communication between the several important seacoast towns being only possible by country roads or by sea. But a plan is now under consideration by which a combination of railway extensions with navigable streams running generally north and south will establish interior lines of travel from the mouth of the Amazon to Rio and the Argentine Republic. Aside from the unfavorable climatic conditions, the topography of Brazil is not adapted to the construction of transcontinental railway lines, even if such lines were more important than is now the case. The great rivers of that empire run north and south, except the Amazon, and are generally separated by rough and mountainous divides. But the same topography will make construction comparatively easy in the opposite direction when the time comes to utilize the vast but little known interior of this great empire.

The Massachusetts Railroad Report.

The series of reports of the Massachusetts State Railroad Commission has been, by universal admission, an honor to the State and a benefit to the country and to the railroad interest, and it is no slight compliment to say, as it is but fair to say, that the twentieth of the series is one of the most valuable, varied, and complete of them all, as it is also considerably the largest. There is solid satisfaction and encouragement in a public document like this, which is obviously free from "politics," and prepared with an evident effort to render equal and exact justice to all, while carefully guarding all just public interests. We are glad to know that there are now many railroad commissions of which substantially the same may be said with equal justice; but there are none of them now, as there have been none in the past, which seem to be quite as completely and usefully fulfilling the ends for which they were created as the original Massachusetts Commission. In a great degree this is because the conditions under which it acts, of size of State and railway corporations, dense and settled population, etc., are more favorable, but the result is none the less satisfactory and creditable.

The twentieth report is to an unusual extent taken up with the discussion of technical as distinguished from financial or political railway problems. It opens with some excellent matter on the question of steam-heating, the neatest thing in which is the effective way in which two arguments against steam-heating are disposed of, the danger from an escape of steam in the cars and the danger of the cars being without heat if left without a locomotive in a snow blockade or otherwise. As respects this latter danger, the experience of four trains on the Boston & Albany, stalled in the blizzard of last March, showed that the engines of three of them had no difficulty in keeping the passengers warm and "could have done so a week," while the fourth train, which was unwisely deserted by the engine, was still made passably comfortable for the night. The moral was, never detach the engine from the train in such cases, as we said last year in discussing the blizzard experiences; and this rule is now established by general orders on that road, as on most others using steam-heat.

The alleged fearful dangers from a broken steam-pipe, which we have contended from the first were purely imaginary, were disproved in the most effective way possible, by a practical test. A car was fitted up, and a 1¼-in. steam pipe opened at once to its full extent about 6 ins. above the floor, pointing across the car, all doors and windows being closed and about half the ventilators open, as usual. It was found that it would not burn the hand held directly in front of the pipe, 3 ft. off. The experiment was tried with all pressures from 80 lbs. down; with the latter pressure the hand had to be held 5 ft. off, but the pressure fell very rapidly, and "all the passengers except the person in the direct line of the steam (who had to move his feet a few inches only to escape), even if the doors and windows were kept closed, could retain their seats with perfect impunity and but trifling discomfort, until the coupling was disconnected or the steam shut off." The experiments usually continued about 2½ minutes, and "the car was simply uncomfortably warm. There was no danger at any time in walking through the car, stepping over the jet of steam."

The reason for this immunity, which the Board do not discuss, is simply this: that when any gas, whether steam, air, or any other, is released from pressure, its expansion alone absorbs an immense amount of heat. A pound of 80-lb. steam expands from 4½ to nearly 26½ cu. ft., losing in the mere process of expansion 61° of heat; but furthermore, in the effort to at once expand so greatly, it is so thoroughly mixed with air that the first steam discharged cools into harmless vapor at once, and the entire air contents of the car must be heated up to nearly a scalding temperature before general harm can result. If there be any reasonable number of ventilators open, an approach to such temperature generates a sufficient current of air to cause the heat to increase very slowly, giving ample time to open doors and windows if necessary.

The report shows gratifying progress in steam heating: 605 cars are so heated against 236 last year, there being some 3,024 passenger train cars in the State, while new cars are now being added daily. In New York the proportion of cars so heated is much larger, compulsory legislation having gone in force Jan. 1, 1889.

The Board also have something further to say about car-wheels, repeating what was said at the time of the Bradford accident in January, 1888, and then discussed by us; and they make a very proper suggestion that a curious bit of legislation be repealed which requires that:

> All switches hereafter laid, . . . including renewals, shall be of the kind known as the Tyler switch, or some other kind of safety switch, approved in writing by the Board.

The Tyler switch was a good switch in its day, and the legislation was no doubt well intended and good in result, for New England practice at the time the law was passed was shamefully backward in the matter of switches, as for that matter it still is; but the Tyler switch was not even then the best to be had, by any means, and the Board do well to make the fact that it helped to aggravate the Bradford disaster the occasion for saying that it "is not generally considered, and is not, in the opinion of the Board, the best switch now obtainable," and to object in the same connection to such endorsement by law of any specific device.

On the great questions of automatic freight car couplers and freight train brakes, the Board also speak out with no uncertain sound, and show wise action. All technical doubts impeding further progress in the introduction of these great and needed betterments have been now for some time removed, and nothing but official inertia stands in the way of their introduction. The Board recognizes and states, therefore, as we have repeatedly done, that now is a particularly appropriate time for legal pressure on the companies, in their interest as well as the public's; and they also recognize that State pressure is not likely to be effective. They accordingly memorialized Congress last year on the subject, as did the Massachusetts Legislature, but nothing came of it. Lately, as we chronicled in our last issue, the same action has been had in the Washington convention of railroad commissioners, the Interstate Commission being formally requested by vote to look into the matter, and "make recommendations in the premises to the various railroads within its jurisdiction, and report its doings to Congress at an early date, with such suggestions as to legislation as may seem to it necessary or expedient." We are not disposed to favor Congressional action in any new field which can safely be left to the States, however clearly within its constitutional powers, but in this case we believe that great good would come from mandatory legislation as to the early use of automatic couplers and steam heating in interstate commerce, which practically means all railway traffic.

The Board also dwell on the same obvious point we have lately mentioned,—that in view of pending efforts to remove grade crossings in many States, it is particularly desirable to get freight brakes introduced, so that the needed clear headway may be reduced from 18 ft. to say 14 ft. We feel the more certain that early compulsory legislation is desirable from the fact that, apart from all other grounds, *it will pay* to introduce the new safety appliances, and pay directly, largely, and at once. The effect of increasing the admissible speed and load of freight trains would be very great, much greater than those who have not investigated that side of the problem would believe. We have no doubt, and we are well within the mark in saying, that if freight rates did not fall (as they doubtless would) the new appliances would earn 100 per cent. per annum on their cost, by increasing the average earnings per freight car from about $1,000 to about $1,075 per year. But each company naturally shrinks from acting much in advance of its fellows, because it incurs the full expense for a mere fraction of the benefit, until such action becomes general.

The report of Prof. GEO. F. SWAIN on the bridges of Massachusetts, which is a prominent feature of the report, is in the main an interesting and valuable document. It shows that there are 1,619 bridges of all kinds of 10 ft. span or more in Massachusetts, on 2,071 miles of road, of which there are:

Wooden bridges (282 mere stringers or trussed stringers, and 187 pile and wooden trestles)	607
Stone arches	149
Iron bridges (164 I-beams, 440 plate-girders, 153 riveted trusses, and 74 pin-connected)	29
Drawbridges (20 of them "jack-knife" draws and 2 mere trussed beams)	883

During the past year 884 of these bridges have been examined, and no less than 193 bridges, or about 12 per cent. in all, have been rebuilt since the Act was passed following the Bussey Bridge disaster of 1887, while 125 others have been repaired and strengthened. The Boston & Providence has renewed 30 per cent. since that fateful day.

The Board justly point out that it does not follow that all these bridges were unsafe: but it may be added, on the other hand, that, as nearly all these renewals have been among the more important structures, if we reduce the above total one-half by cutting out the trestles, stringers, and other trifling struc-

tures, the percentages become doubled. It then still more strongly indicates, what was undoubtedly the fact, that Massachusetts bridge practice was previously at a pretty low ebb.

The predominance of "jack-knife draws" is another evidence of this latter fact. They are a wretched and dangerous kind of structure, giving a train no chance at all if derailed on or near to them; and the great majority of those in Massachusetts, moreover, are in particularly exposed situations, as respects number of trains, if not of speed. There is no real justification or excuse for using them at all, and they ought all to be taken out, and renewed with rational structures as soon as possible. It is a pity the report does not state this frankly: instead of doing so, it makes the weakest and most illogical suggestion on the subject that we have observed in it, or for that matter, anywhere else very recently. After pointing out the evident fact that it is "impracticable" to protect the track over them by any system of guard-rails, for the reason that there is no floor to carry guard-rails on, and hence that disaster to a derailed train is certain, the report continues (italics ours):

In such cases, where practicable, it would be advisable to use a rerailing guard at each end of the bridge, for the purpose of returning a derailed truck to the track if possible.

The query naturally arises: If "in such cases" it is advisable, "where practicable," to invest $20 or so in a few pounds of cast-iron to save an otherwise certain disaster, at what point of cost or danger does it cease to be likewise advisable to use the same device, where "practicable," to save disasters to derailed cars on other bridges which are merely probable instead of certain. For every railroad man knows that disaster is always the most probable result to a derailed train on a bridge, guard-rail or no guard-rail. How great, in the judgment of Massachusetts engineers, must be the danger to a derailed train before an investment of $20 per bridge becomes "advisable if practicable" or how much cheaper than $20 must such a safeguard be before its use becomes "practicable" as well as "advisable?" We assume that the saving clause "if practicable" refers to prohibitory expense, because it is capable of no other rational meaning in this connection, it being always practicable otherwise, the roadbed being always able (unless the ties are unusually rotten) to sustain the dead weight, and the track being always long enough (unless the road be unusually short) to give the rod or so of necessary space for it at each end; while we have no belief that, given the ties, the roadbed, and the frogs, there are any trackmen in Massachusetts so ignorant that they would not find it "practicable" to spike the frogs to the ties.

It would be hard to damn a great safeguard with fainter praise, or discourage its use, more effectually than this brief sentence is liable to do; which is the more to be regretted as it is absolutely the only possible protection for the "jack-knife draws." We shall be greatly mistaken if the jack-knife draws around Boston are not heard from in some grievous way one of these days, and we shall then have the melancholy satisfaction of referring back to this article, and saying, "I told you so."

We find that we have exhausted our space just as we were coming to one of the best features of the report, the extended discussion of the subject of trespassers and deaths at grade-crossings. As bearing thereon, two very valuable special reports are given on English and German practice, and taking these likewise into account, we have not lately seen a more valuable and exhaustive discussion of a great practical question. We must postpone to a later occasion any attempt to review this matter and the further contents of the report, as we certainly purpose doing, and will only add now that this and other like reports, including especially the Interstate reports, bear gratifying evidence to the progress which is being made in the effort to establish public supervision of railway management on a basis which shall be at once rational, just and effective.

The Plea of the Manhattan Railway.

The letter of Mr. JAY GOULD to Mayor GRANT concerning rapid transit in this city contains a very considerable amount of statistical meat concerning the operation of the Manhattan Elevated Railway. There can hardly be a doubt that the enlargement of terminal facilities at the City Hall and South Ferry stations would be beneficial to the roads and their patrons, and in the interest of these patrons it is to be hoped that something will be done soon in that direction.

But we cannot agree with Mr. GOULD in supposing that with these improvements the Manhattan system can meet all the demands of the present and the near future in the way of rapid transit. The present system of lines is undoubtedly well managed, remarkably so; and the cars are "well lighted, well warmed, and well ventilated" as Mr. GOULD says. But at the hour when we all want to use them, they are also too well crowded, and the "uninterrupted perusal of a newspaper or magazine during the entire length of the journey" referred to, is pure fiction. What we want is the extension of facilities on the Manhattan to the utmost limit of comfort and safety, and other lines besides, to assist this system in conveying the multitude that, even with the enlargement desired, it cannot and does not convey in a properly decent manner in "the rush hours."

Mr. GOULD, however, fails to explain why his company should not buy land on its own account for this very desirable increase in terminal facilities. The property required would cost a large sum of money; but the company is rich, and the privileges it now enjoys from the City of New York are so great that it seems neither just nor proper for it to expect further concessions from that source. Right-of-way over the streets of this city for any elevated structure will probably never be granted again, unless coupled with a round tax for the privilege, and the necessary real estate is now the big and troublesome end of any rapid transit project, including elevated roads. For these reasons Mr. GOULD'S system will always have an enormous advantage over any future competitor, and it is just a little presumptuous to demand that this advantage should be transformed into a practical monopoly by further grants solely at the expense of the city that has already conceded too much to this corporation.

But whatever we may think of the force of Mr. GOULD'S argument, his figures are interesting and useful in any solution of the rapid transit problem. He takes an honest and commendable pride in the statement that up to Jan. 1, 1889, the lines operated by the Manhattan Co. had conveyed the enormous total of 1,069,487,620 passengers, and of this number but one had been killed while in the cars, and in all only 47 lives were lost upon the structures of the road; and the officials claim that not one of these latter lives was lost without some act of negligence on the part of the victim contributing to the fatal result.

In referring to the growth of travel during the past two years, it is stated that almost the entire increase is in the former "10-cent hours,"—a fact which can be readily understood when we consider that the "5-cent" crowd of former years was so dense that the limit of packing was reached long ago. For this reason the increase in the year ending Sept. 30, 1888, was only "a little over 8 per cent. in the commission hours" and nearly 92 per cent. in the old "10-cent hours. The too evident result is that now the cars are practically crowded all day instead of in certain hours only, as was the case before the fare was made uniform.

The express train service is now excellent, and a distance of 11 miles is made in 33 minutes on special trains connecting with the N.Y. & Northern R.R. Mr. GOULD thinks that by completing a third or middle track on Third and Ninth Avenues, these could be used for through down-trains in the morning and up-trains in the evening, running at a speed of 25 miles per hour. But at present less than 5 per cent. of the entire travel goes between the Harlem river and City Hall Park, and such express service would do little to relieve the main lines, though it might increase the growth of the city at the Harlem end.

Mr. GOULD says that his roads now pay over $600,000 per annum as the total of taxes due the city. This is a large sum, but the interest on the real estate that its thirty-odd miles of road would require, if honestly bought and not granted, would consume a vastly greater amount of money. There is no doubt that the extension of the elevated lines into upper New York has led immediately to an increase in the price of real estate and in the development of this region, and Mr. GOULD figures that between the years 1879 and 1886 the total increase in the valuation of real estate in the City of New York was $312,892,678. But as an offset to this and as an immediate consequence of this development, the value of Manhattan stock has also increased, and the growth of New York hardly seems a sound basis for a demand for further concessions, which is the end aimed at in the communication referred to.

Nor do we agree with the implication conveyed in this letter that the only alternative to an enlargement of the Manhattan is "the half-lighted, dingy cars of an underground road." Plans might be brought forward that would have all the advantages of the Manhattan and some others in addition. As the acquisition of real-estate must be considered in a future elevated road, probably the cheapest and most satisfactory solution would be to go up still higher in the air than do existing roads, say 60 to 90 ft., and use spans of about 260 ft. springing from substantial fireproof towers located in the centers of the blocks and carrying four lines of rails. Elevators would of course be required to reach such a system, but they already enter into other plans, are feasible, and can be made safe and sufficient The advantages are that the real-estate under the road-bed—which we suppose to be purchased—can be made to yield ample rentals; and that part of the project resolves itself into an investment rather than an expenditure. The truss used would necessarily be heavy and would in itself absorb much of the noise that is now a nuisance on lower tracks; and further, it would be so far above the ordinary living line that what noise there is could hardly be objectionable. The danger from a great fire to such a structure is becoming less each year; but what danger there might be could be met by carrying a large main on the truss which could be made useful in a number of ways, in the protection of the structure and buildings under it, in the general supply of water, and perhaps in running the station elevators. Such a system would have almost perfect freedom of alignment, and the elevated character of the struc-

ture would permit other lines to cross over or under it. There may be some objections on the score of esthetics, and some timidity in using such a line in the "old women of both sexes," but these are objections that time will overcome, if the service is rendered, as happened in the case of the present elevated roads.

But if we must go underground, then the parallel scheme of sinking the line deep enough to be free from street alignment and beyond any proven damage to real estate, would seem to be the best. We agree, however, with Mr. GOULD to the extent of always preferring daylight travel to tunnel transit, and in this we believe we are in accord with the great majority of the traveling community. Electricity, as a producer of motive power and light, may yet do much to improve underground travel; but until the requisite improvements are made and tested, underground transit will not be popular.

The Proposed Bureau of Harbors and Water-Ways.

The following substitute for the House Bill No. 4,923, proposing to better regulate the conduct of public works in the United States, was reported by Mr. LAFFOON from the Committee on Expenditures in the War Department, on Feb. 19, 1889, and read twice and ordered to be printed:—

The bill proposes to form under the War Department a Bureau of Harbors and Water-ways, to be officered by a corps to be known as the Corps of United States Civil Engineers. This bureau is to be charged with the construction, execution, conduct, and preservation of harbors and water-ways and all other work of a civil character that may be placed under the direction of the Secretary of War.

Section 3 provides that no money shall be expended upon such work unless the appropriation is sufficient to complete the work, or other provision be made by law to provide funds necessary for completion. Exceptions are made to this provision in the case of snagging and dredging operations and the care of plant, or works, etc.

Section 4 provides that in the preparation of plans, estimates, recommendations for attention in plans and estimates, etc., and reports upon progress, all such reports shall be made to the officer next in authority, and then transmitted, with views and recommendations by each official, to the Secretary of War, and by the latter to Congress.

Section 5 provides that all work be done by contract after due advertisement when the Secretary is satisfied that the interests of the Government can be best served in this way. There must be adequate bond and security for the faithful performance of work.

Section 6 relates to the personnel of the Corps. The Chief Engineer is to be located in Washington, and must be a man learned and experienced in civil engineering, especially with reference to harbor and water-way work. Four other Associate Chief Engineers of like acquirements shall also be located at Washington; one of these to be assigned to duty in the office of the chief and the others put at the head of such divisions of the work as the Secretary of War may approve or direct. These engineers also constitute an advisory board for all questions submitted to them by the Department Engineers, by the Secretary of War, or by Congress. There shall not be more than 11 or less than 9 Department Engineers located at central or convenient points in the departments made. There shall be 50 Division Engineers in charge of work in the several departments, and not more than 100 Resident Engineers, who are to have local charge of work under the Division Engineers. To assist the Residents and to perform such duties as may be assigned them, there are to be not more than 200 First Assistant Engineers and not more than 250 Second Assistant Engigeers. All members above the grade of First Assistant Engineers shall be known as officers, and all members must be citizens of the United States.

Section 7, relating to appointments, provides that the Chief Engineer, Associate Chiefs, Department, Division, and Resident Engineers shall be appointed by the President by and with the consent of the Senate; and, excepting in the case of the Chief Engineer, these appointments and assignments are made on the recommendation of an examining board to be provided. The First and Second Assistants are appointed by the Secretary of War upon such tests as may be provided in the rules and regulations.

In making appointments to the corps below the grade of Division Engineer, they shall be made on the basis of work to be done, and with special reference to experience, capacity, training, and fitness for work assigned to this corps. On a vacancy occurring in the office of Chief Engineer, it is to be filled from the grade of Associate Chief Engineer, and all vacancies in all other grades are to be filled in like manner from the next lower grade. It is provided, however, that every third vacancy in the grade of First Assistant, every fifth vacancy in that of Resident, and every tenth in the grade of Division Engineer may be filled by engineers, not formerly members of the corps, who may present themselves as candidates and submit to such examination as provided in the rules and regulations. Below that of Associate Chief the relative rank of all grades must be determined by date of commission, and promotion is in the order of seniority, provided that such senior is recommended for promotion by the examining board. The Secretary of War determines the needs of the service, the number of vacancies to be filled by promotion and appointment, and convenes a board to examine and recommend candidates for promotion in the grades named.

The pay of this corps is to be as follows:—Chief Engineer, $10,000 per annum; Associate Chief Engineer, $7,500; Department Engineer, $6,000; Division Engineer, $4,000; Resident Engineer, $2,700; First Assistant, $1,800 and Second Assistant $1,200. All travelling expenses are to be paid when under orders. The Secretary of War may employ special engineering counsel when he deems it necessary, and may also employ engineering assistants of the two lower grades for temporary work. When any officer arrives at the age of 65, he shall be retired from active service on the half-pay of his grade, but such officer must first have first served in this corps or the corps of military engineers for the 10 years immediately preceding his retirement. No member of the corps can be employed upon outside work except on the special order of the President.

In establishing this corps, the Chief Engineer may be assigned from the Corps of Engineers, United States Army, but he must not be lower in rank than a Colonel in the military corps. Half of the Associate Chief Engineers may also be assigned from this corps, of rank not below that of Lieutenant Colonel. Five out of nine, five of ten, or six of eleven of the Department Engineers may be taken from the grade of Major; one half of the Division Engineers may be taken from the grade not lower than Captain; and 20 of the Resident Engineers may be taken from the Corps of U. S. Engineers of not lower rank than First Lieutenant. All such assignments must be made on the recommendation of the board of examiners. Engineers from the army assigned to duty in this corps are to take rank alternately with the civilians commissioned, and shall receive only the pay of officers in the army on detached duty until they shall be duly commissioned on the new corps. Army engineers so assigned shall at the expiration of 4 years from the passage of this act resume their connection with the army without impairment of rank, unless they meanwhile elect to remain in this corps.

To formulate a system of rules and regulations for the proper administration of this corps, the President is to appoint a commission of three army engineers and three civil engineers, all of high attainment in engineering ability and skill. This commission shall also nominate to the President such civil and military engineers as are specially fitted for assignment to the grades of Associate Chief, Department and Division Engineers. Members of the Commission not under Government pay are to receive $450 per month. After the work of this commission is completed, the President shall appoint an examining board which shall nominate men for the other grades of the corps. The remainder of the act refers to the division of the country with reference to its harbors, etc., into not less than 9 nor more than 11 departments.

Electric Welding Experiments.

At the second exhibition of the welding machines manufactured by the Thomson Electric Welding Co., of Boston and Lynn, Mass., given at the station of the Malden Electric Co., Thursday evening, March 7, there were present nearly 30 electricians and engineers. An Armington & Sims high-speed engine of 60 H. P. was used exclusively for the generation of the electric current, and this was applied to three of the welding machines on exhibition, as required. The machines differed in details of construction, but were all those used upon what is called the indirect system, in which the ordinary alternating high potential current is generated by the dynamo, and transformed in the welding machines into the low potential but large quantity currents required.

The latest form of these machines may be described as built up upon a straight tube of thick copper, specially drawn, and about 3 ins. in diameter, which is held horizontally in the frame of the machine. Around this tube are packed disks or washers of thin iron, called the field. The current from the generator traverses successively twelve coil, which pass longitudinally over the surface of the cylinder formed by the field, and through the central tube, returning thence to the generating dynamo so as to form a closed circuit.

Attached to each end of the copper tube, the ends projecting somewhat beyond the cylindrical field, are two heavy copper bars or arms, extending horizontally and at right angles to the tube, to which are attached the clamps, which may be of any convenient form, by which the metal pieces to be welded are held. The other machines had two coils for the primary or high tension current instead of twelve, and the clamps were placed upon the side or top of the machine, but did not differ in essential arrangement or principle from that above described.

The machines did much the same work as during the previous exhibition, welding ½-in. and 1-in. iron bars, etc. The clamps were placed 2½ ins. apart or 1¼ ins. from the joint to be welded, on a 1¾-in. pipe, and the weld was completed in exactly one minute from the time the current was turned on. To weld a 2-in. bar of wrought-iron, the entire current generated by the 60 H. P. engine occupied 1 minute 20 seconds in heating the joint to the welding temperature, when the pieces were squeezed together by a worm and ratchet handle attached to one of the clamps, and the weld was completed in 5 seconds, making 1 minute 25 seconds in all.

Among the advantages of the process, which were very apparent, were the quickness of the operation and the ease of handling, since a bar could be held in the hand within 6 ins. of the weld just formed, because the heat has not time to conduct itself through the bar to any considerable extent before the weld is completed. The pieces can be accurately adjusted before welding, the whole operation watched and regulated, and the pieces kept clean. The welds are necessarily perfect, because of the fact that the heating generally begins at the center of the bar or piece, and equalizes itself throughout the entire cross-section, since the welding current passes through the clamps and joint where it always heats, at the point of greatest resistance. There are two principal sizes of the welding machines, one for small work having a capacity from ¼-in. to 1-in. bar iron. The largest bar yet welded on the large machine is 2 ins. in diameter.

Besides these machines, direct welding machines have been made which are run directly from the engine or shafting, and generate the current and transform it into the welding current in the same machine. Thus far the direct welding machines have been able to weld up ⅝-in. copper and 1¼-in. iron.

As to the strength of the welds, a piece of ¾ in. pipe was shown that had been flattened by hammering at the weld, in which the lap weld of the pipe had given way, and a crack was made across the circular weld made by the welding machine, without affecting the latter.

Samples were shown of electric riveting, forging and shaping of metals,—a broken pocket-knife with the blade welded on, an axe with steel cutting edge welded, etc. etc., Some half dozen of the welding machines are now in use for bicycle work, and undoubtedly the applications of the process will be rapidly extended.

What remains to be achieved is the power to weld larger sections up to 8 or 10 sq. ins. When this is done, the field of the process will be enormously extended.

CORRESPONDENCE.

Standard Rivet Symbols.

Phœnix Iron Works, PHŒNIXVILLE, Pa., Mar. 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

The correspondence in your issue of Jan. 26, Feb. 9, and March 2 relative to Standard Rivet Symbols has been read carefully and with much interest, and needs discussion by all interested.

Taking the original system as a whole, I am decidedly in favor of adopting it with a few slight modifications, which have been either suggested by the correspondence or raised in the shop. These are of such a nature as to be readily made without disturbing the original code of Mr. OSBORN'S and will relieve it from some ambiguity. They are as follows:

1. In every case where the word "inside" is used, modify it by the parenthetical clause (Reverse Side).

2. In every case where the word "outside" is used, modify it by the parenthetical clause (Side Shown).

3. For the flat head ⅛-in. high, substitute "Flattened to ⅜-in. high (countersunk and not chipped)" for "Flattened to ⅛-in. high or countersunk and not chipped."

The reasons for suggesting these modifications are as follows:

1 and 2. There is apparently no clear understanding of the terms "outside" and "inside." This has been pointed out in your issue of March 2, and we have had the question raised in our shops and drawing room. The correspondence already printed shows that by one party the *side shown* is understood to mean the "inside," and by another the "outside." Without a definite understanding of these terms, our code is not fit to be a standard, and I offer the above modifications, which are very easily added to existing copies, and will, I feel sure, obviate the uncertainty. That they are the best interpretations of the terms I am not prepared to say, but they have the advantage of always supplying an "outside" and an "inside" to any plan or elevation whatever, and in case of a box member shown in side elevation, the term "inside" will mean both the inside of the member, and the "reverse side" of the view shown. In the case of sectional elevation of box members only, will the term "inside" mean the outside of the member, but by the explanatory clause "reverse side," it still makes the exact position of the work apparent.

3. There is a decided objection to allowing the use of a flat-headed rivet ⅛ in. high, without countersinking the hole, and the explanation of the symbol as it stands undoubtedly intends this. By the change suggested, a countersunk hole will always be made in the work, and all hands in the shops easily come to regard it as nothing more than a countersunk rivet, which may have its head ⅛ in. above the surface of the metal.

The sooner all those who have adopted Mr. OSBORN'S code agree as to the signification of the terms "outside" and "inside," the better it will be for all, and if the above methods be not in accordance with the views of the majority, we shall be glad to adopt the reverse meanings for the sake of uniformity. Very truly,

SAMUEL TOBIAS WAGNER,
Supt. Shops.

Concrete Construction.—Tie-Plates.

NEW YORK, March 18, 1889.

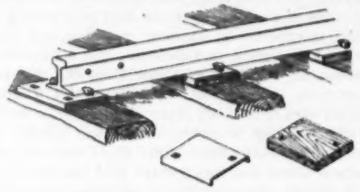
TO THE EDITOR OF ENGINEERING NEWS:

Three articles in your issue of March 16 especially interested me.

First. Your editorial on Mr. JOHN ERICSSON, the eminent engineer and inventor. With you I regret that the opportunity for civil engineers, as a body, through a representative society, to show their respect for him, was neglected.

Second. The article on the building of the St. Augustine, Fla., hotels with cement concrete. It may be a matter of interest to correct one statement in its closing paragraph: "These buildings are a striking and most interesting example of both economical and effective concrete construction; the *very first* of their kind in this country, and to the best of our knowledge surpassing anything attempted elsewhere." "This country" conveys to me the idea of the United States. Between the years 1860 and 1870 I observed several concrete dwelling-houses, etc., already built and also in process of construction in California. I was very much pleased with the facility and cheapness of this mode of construction, and have since had frequent occasion to recommend it. The buildings are substantial, easily and quickly constructed, cool in warm weather, warm in cold weather; the concrete is susceptible also of great ornamentation. The coquina of Florida, being a conglomerate of shells, is especially adapted to this method of construction and will prove a success.

Third. The Servis tie plate. Herewith is a cut and description of the Perkins plate, which has not the objection you state, "that they cut two new grooves for local rot to start in," and which has the great advantage of a cushion between the rail and the tie, acting in the same manner as the piece of wood which a cabinet maker uses between his hammer and the fine piece of wood which he manufactures. These plates were tried a few years ago on railroads in various parts of the United States, free samples for a few rail-lengths being furnished by the parties owning the patents.



The Perkins Tie-Plate.

The results have been invariably successful. Among the above roads were the Boston & Maine, Portsmouth & Concord, Erie, St. Louis, Iron Mountain & Southern, several of which were visited by me one, two, and three years after the plates were inserted. In every case there was almost an entire absence of tie cutting, while the contiguous ties under the same travel were badly chopped.

Why were these plates not put in further use? The answer would seem to be that railway officials are so occupied with the onerous duties now required of them that they cannot spare time to investigate such "small matters" unless pressed upon their notice.

The home of this tie plate was Portsmouth, N. H., but I have not heard that it has been pushed of late.

Yours truly,

ROBERT L. HARRIS.

[We have never heard of this particular tie-plate before. We shall be pleased if any of our readers can give us further results of actual experience with it. While it does not "cut grooves" for new rot to start in, it does bring two wood surfaces together under conditions which might start rot, and on a larger scale.—ED. ENG. NEWS.]

The Bowers Hydraulic Dredger.

SAN FRANCISCO, Feb. 27, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Several years ago, while proprietor of the Novelty Iron Works in this city, I constructed for A. B. BOWERS, a small rotary hydraulic dredger costing about $12,000. Under careful and accurate tests, this machine delivered 6 1-2 cu. yds. per minute of exceedingly hard and tenacious material through 320 ft. of pipe and hose, and at a total expenditure of a little over 47 indicated H. P.

For the last two years another of the Bowers Patent Dredgers has been working at Kansas City, discharging sand over an embankment varying from 12 to 19 ft. above the water. The power of this machine has never been indicated, but the engine is smaller and the machine cost considerably less than the one above referred to. It has handled as high as 27,000 cu. yds. in a month.

For more than a year past, I have been engaged in constructing and testing other of these machines. One of these, Dredger No. 3, is now working at Glorietta Bay in San Diego, and in material consisting of about 90 per cent. of sand and shell, with enough clay to fill the interstices. For several inches from the surface it is quite soft, but gets harder and more compact as you go down, and at the depth of about 3 ft. it becomes so hard that an iron pointed vertical anchor or "spud," weighing 2½ tons, and dropping 12 ft., will penetrate but 3 ins., or but 8 ins. on being dropped three times.

In the lower or harder portion of the excavation, this machine cuts, raises, and delivers through 258 ft. of 18-in. pipe, 4.19 cu. yds. per minute, with an expenditure of 188.79 indicated H. P. on the engine that drives the pump, which is a direct-acting Westinghouse, constructed expressly for this machine.

When working at a depth of 5 ft. from the surface, the delivery was 7.66 cu. yds. per minute, and the indicated H. P. 192.75. In working at a depth of 3 ft. from the surface, in the less compact material, the delivery was 12.79 cu. yds. per minute, with an indicated H. P. of only 179.98. On a run of 5 hrs. and 20 min., the output was 3,630 cu. yds., or an average, including stoppages for feeding forward, of 9.46 cu. yds. per minute. I have constructed a great many dredgers of various kinds, and as this is the best performance of which I have any knowledge, I send it to you as a matter of interest to the engineering profession. Respectfully,

G. L. PIERCE.

[Since the receipt of the above letter Mr. BOWERS himself has called at this office and corroborated the statements made, and left with us a photograph of the dredge used at San Diego. Mr. BOWERS says that he has special cutters designed for hard and soft material, and by a misapprehension of the character of the material to be handled at San Diego, the cutters for soft ground were used. By a substitution of the proper cutters, the results will be largely increased. The parties who built the Kansas City dredge referred to have since then constructed another of 300 H. P. which will soon be in operation, and contemplate the building of a third machine of very much larger capacity still. ED. ENG. NEWS.]

The American vs. the English System of Keeping Level Notes.

TO THE EDITOR OF ENGINEERING NEWS:

The object aimed at in taking levels is to obtain the elevation of certain points above a certain other point or plane.

Ordinarily the number of observations on stations exceeds the number of observations on turning points five or six times, and in the arithmetical operations necessary to obtain these elevations from the notes taken, it is desirable to use that method which requires the least mental effort.

The general requirement of the best method would be absolutely accurate results for *all* observations with the least work. Station elevations are unsafe to use until checked, we were always taught. In fact, we had to check all of our elevations before using them, and the English system is the only one in which this can be done without loss of time, the interposition of a single station between turning points insuring the arithmetical accuracy (see table) of all of the work done. This we consider of itself of sufficient importance to decide the controversy in favor of the English method, unless the labor involved was double that of the American method to obtain the same result, because the labor in the English method is so distributed as to be inappreciable, while checking by the American method is an unmitigated nuisance.

Now let us see which method actually does require the greater number of mental operations. We take an example at random from our notes:

English Method.

Sta.	*B. S.*	*F. S.*	*Diff.*	*Elevation.*	
37.	0.20			102.65	
38		4.70	4.50	98.15	
39		7.04	2.94	95.21	
40.	0.17	11.15	3.51	91.70	For test fall 10.95
41		4.60	4.43	87.27	
42		9.36	4.76	82.51	
43.		11.99	2.63	79.88	For test fall 11.82

Successive differences are first taken, and then, to check, the total difference between *B. S.* and *F. S.* on turning points, absolutely proving all of the operations. To obtain the elevations in the above example, 147 mental operations are needed. To prove their correctness, 54; total, 201.

American Method.

Sta.	*B. S.*	*H. I.*	*F. S.*	*Elevation*
37.	0.20	102.85		102.65
38			4.70	98.15
39			7.64	95.21
40.	0.17	91.87	11.15	91.70
41			4.60	87.27
42			9.36	82.51
43.			11.99	79.88

To obtain the elevations, 105 mental operations are needed; to prove their correctness 105; total 210.

This is a slight advantage in mental operations when you go through the process "2 and 2 make 4" fashion; but in using the English method, it is hard to do it so laboriously. Our first trial of the above resulted in only 118 operations, and the actual number, working as we usually do, would give about 90 to prove.

We rarely use the column marked "Differences," are never annoyed by having arithmetical errors running through page after page of notes, always have our notes worked up and proved before the office is reached, and therefore always ready for immediate use, not one of which advantages can be claimed for the American method.

We believe that the sample given is a perfectly fair one; we have records in which the turning points outnumber the stations twenty to one, in which case we believe there is no choice between the methods. We also have a record of 181 station readings from one backsight, in which case there is absolutely no comparison, the English being superior without a question.

This last was a case of cross-section work from which quantities were to be calculated, and it was essential that every elevation should be correct.

We have found the English method the easiest to teach to assistants; and have found that the more a person uses it, the faster he can work and the less the conscious effort becomes, until finally it becomes a matter of routine, and results are written down from the combination of figures with as little conscious effort as a person feels in combining the letters in a long word into the word itself.

Respectfully, HILL & STOUT.

[There is no accounting for tastes, nor for ideas of what a "mental operation" is. According to our count, it requires 2 additions and 12 subtractions, or 14 operations of that kind, to make the first table of notes above, and 4 more subtractions to check them. To make the second table of notes only 2 additions and 6 subtractions in all are required, or 8 in all, and if the checking involved doubling this, it would be only 16 against 18. Practically, however, it does not. A dozen or twenty turning-point back-sights and fore-sights may be added together at once to check the main elevations, at any convenient moment (in good work errors are rare), while the station elevations are readily checked, not by repeating the subtractions, but by adding together elevation and reading, which should make the same height of instrument every time, and an error, if it be found, affects only one station. The "English" example above is ingeniously—or fortunately—chosen to show only a series of uniformly decreasing elevations; but with the usual alterations of up and down, there is an additional and very puzzling "mental operation" besides those enumerated above, to determine whether an addition or subtraction is required. In the "American" style, the routine of addition and subtraction is always the same. In so essentially simple a process, almost any system of keeping notes may become a "matter of routine," but the fact that the "American" system has all but completely supplanted the other, which was the only one known or taught 30 or 40 years ago, is pretty strong evidence that the newer system is the best by far. We have now given both sides fully, however, and leave our readers to choose for themselves.—ED. ENG. NEWS.]

The Limit of Maximum Curvature.

NORWICH, Conn., March 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Can you refer me to a work which will tell me on how sharp curves it is practicable to run modern locomotives and ordinary trains?

I wish to ascertain whether it is practicable to use a loop with radius of less than 300 ft. with speed of 5 or 6 miles per hour. Yours truly,

C. E. C.

[Mr. WELLINGTON'S "Economic Theory of the Location of Railways" gives the most detailed information on subjects of this nature of any book in print. We presume our correspondent can find in it what he wishes to know. His question is too general to be answered here. It depends altogether on the use and importance of the loop whether it is "practicable" to use a 300-ft. radius on it. It is certainly possible to do so, and run any kind of train around it occasionally; but whether it is expedient to do so, which we presume is what our correspondent has in mind rather than bare possibility, is another question. Curves of less than half that radius have been used to handle a heavy traffic over; but they are not exactly general favorites.—ED. ENG. NEWS.]

Notes, Queries and Answers.

Mr. GORDON DINSMOOR, of Topeka, Kan., asks if we consider iridium a good substitute for ruby or other precious stones as a center for compass needles. It would doubtless be good enough, but very costly. "Rubies" are only used theoretically as centers in compasses; diamonds would in fact be cheaper.

Mr. L. M. CLEMENT, of Oakland, Cal., in regard to the priority of invention in a diagram for solving triangles (referred to in our issue of Mar. 2, p. 190), says that Mr JOHN W. NYSTROM published his diagram in 1854, and not in 1867, as stated in the letter of Mr. LORINI.

L. H. STONE, C. E. (R. P. I. '69), of Des Moines, Iowa, writes that he has used the Wredes hand-level, described in issue of Feb. 9, since 1870. He finds it very convenient for preliminary work and cross-sectioning.

PERSONAL.

Mr. D. K. STEVENS, Secretary of the Cleveland & Canton, has resigned.

Mr. P. A. PERKINS has been appointed City Engineer of Ogden, Utah, with a salary of $1,800 per year.

Major J. F. JONES, of Blacksbury, S. C., has been appointed Superintendent of the Charleston, Cincinnati & Chicago, vice Col. J. H. AVERILL resigned.

Mr. W. K. ACKERMAN, of Chicago, has been appointed Receiver of the Bay City & Battle Creek and Battle Creek & Sturgis railways.

Mr. SAMUEL SPENCER, formerly President of the Baltimore & Ohio, has become connected with the banking firm of Drexel, Morgan & Co. as its railway expert.

Mr. CHARLES MORTON has been appointed Superintendent of Sewers, at Boston, Mass., for the year beginning in April.

Mr. GEORGE M. WOODRUFF, of Litchfield, Conn., and Mr. WILLIAM H. HAYWARD, of Colchester, Conn., have been reappointed Railway Commissioners, each for a term of four years.

Mr. EMMONS BLAINE, General Freight and Passenger Agent of the Chicago, Santa Fé & California, has been appointed Vice President of the West Virginia Central, with headquarters at Baltimore, Md.

Mr. GEO. H. DANIELS has been appointed General Passenger Agent of the New York Central & Hudson River road to succeed the late Mr. HENRY MONETT.

Mr. COURTLAND C. MATSON, of Greencastle, Ind., has been appointed Chief Solicitor of the Louisville, New Albany & Chicago, vice Col. GEO. W. FRIEDLEY deceased. His office will be at Lafayette, Ind.

Mr. T. A. STARR has been appointed Receiver of the Canada & St. Louis, with offices at Wabash, Ind., Mr. J. J. BURNS has been appointed General Manager.

Mr. W. C. TURNER, Manager of the Edison Electric Light Co., of Columbus, O., has resigned to accept the position of General Superintendent of the main Edison company at New York, with charge of the company's isolated plants.

Mr. F. A. HILL has been appointed by the Oregon Improvement Co. to be Superintendent in charge of the operation of the Columbia & Puget Sound Ry., Newcastle mines, Franklin mines, and the saw mill at Seattle. Mr. H. W. MCNEILL is Resident Manager of the company.

Mr. ALFRED CRAVEN, in addition to his duties as Division Engineer of the Third Division on the New Croton Aqueduct, has had the care of the Fourth Division assigned to him. Mr. S. F. MORRIS, formerly in charge of the Fourth Division, has been assigned to office duty.

Mr. J. LOWRIE BELL, formerly traffic manager of the Philadelphia & Reading R. R. Co., has been appointed Superintendent of Railway Mail Service by Postmaster General WANAMAKER. The selection is considered a very strong one.

Mr. CHARLES J. HARVEY, City Engineer of St. Johns, N. F., is in this city in consultation with Mr. RUDOLPH HERING concerning a new and complete drainage system for St. Johns. The scheme under consideration is the Rawlinson separate system. About 10 miles of sewers will be built, two miles being brick and the remainder pipe. Work will probably be commenced on July next. St. Johns is now entirely without any public or systematic drainage.

PUBLICATIONS RECEIVED.

—Hornig's Direct Power Steering System. Pamphlet, 14 pp. Published by J. L. HORNIG, M. E., and E. S. WELLS, Jersey City, N. J.

—Proceedings of the Sixth Annual Convention of the Roadmasters' Association of America. Held at the Metropolitan Hotel, Washington, D. C., Sept. 11, 1888. Pamphlet, pp. 123.

—Proceedings of Sixth Annual Meeting of the New England Roadmasters' Association. Held at Boston, Mass., Aug. 15-16, 1888.

—Rainfall of the Pacific Slope and the Western States and Territories. A Report to the Secretary of War by Brig.-Gen. A. W. GREELY, Chief Signal Officer. Pub. Doc. Large 8vo, pp. 101, 15 large plates and full tables.

This most valuable and complete publication, shedding much new light on the rainfall of the "arid" regions of the United States, should be procured by everyone interested in its subject matter. The plates show for the region covered the maximum, minimum, and average yearly rainfall and the mean for each month in the year. We give an abstract elsewhere of the chief points of the report.

—Journal of the Franklin Institute.—March, 1889. Published by the Franklin Institute, Philadelphia.

This number contains the following papers:—"The Transmission of Power by Electricity," F. J. SPRAGUE; "Some American Contributions to Meteorology," Prof. WM. M. DAVIS; "Industrial Applications of Cotton-Seed Oil," ROBERT GRIMSHAW; "The Debt of Medical and Sanitary Science to Synthetic Chemistry," Prof. S. P. SADLER; "Permeability of Cements," Translated from the French by Prof. L. M. HAUPT.

—The National Filter and System of Purifying Water.—Issued by the National Water Purifying Co., New York. February, 1889.

This is an illustrated description of the company's system, and contains views and particulars of plants which have been put in. There are also a number of testimonials, and a list of parties using the filters for different purposes.

—Ninth Annual Report of the Board of Railroad Commissioners of the State of California. For the year ending Dec. 31, 1888. A. ABBOTT, P. J. WHITE, JAS. W. REA, *Commissioners.* 6 x 9¼ ins. 297 pp., cloth bound. Published by the State.

The report is accompanied with a very good map of California showing the different systems in colors. There are also several sheets giving profiles of the Southern Pacific system main lines from San Francisco to El Paso, to Ogden and to Portland, each of which is compared with the profile of the Lake Shore & Michigan Southern and the New York Central & Hudson River railroad between New York and Chicago. The map and profiles are placed in a neat pocket on the back cover so that they can be examined without danger of injury. Another map which accompanies the report, showing the relative population per square mile of different sections of the country, loses a large part of its pertinence from the fact that it is based on the census of 1880. The changes in population since then have been so great that quite a different showing would be made now.

—Catalogue of Railway, Steamship, Machinists', and Contractors' Tools and Supplies, Light and Heavy Hardware, etc. THORNTON N. MOTLEY, 26 Liberty St., New York. 4to. pp. 359; 2,871 engravings.

This magnificent catalogue is one of the most elaborate and costly of the many costly and elaborate catalogues which are issued by manufacturers and dealers from time to time, and seems to cover almost every variety of small machinery, tools, notions, and metal supplies, from locomotives down to tacks. The encyclopedic character of the work is indicated in a measure by the enormous number of engravings, 2,871, and still better by the index, which is so extensive as to require (or at least to be furnished with) a cut index at the side for turning to the exact page required, and which, by a rough count which we have made, contains references to over 6,000 different tools and articles of manufacture. Such immense publications stand on a very different basis from the ordinary circular or catalogue. They contain an immense amount of information, much of which it is difficult to find in print elsewhere, and are of permanent value for reference. It is to be hoped that some copies of this and a few other like catalogues (we know of but one fairly comparable with this) will find a permanent home in some of our public libraries, as they are far more valuable and definite evidence of the state of the arts at the time of their publication than is to be found in most technical publications; and we might add also that few books published for sale have equally good print, paper, binding, and engraving, all of which are in this volume unexceptional.

—Sixth Annual Report of the Board of Railroad Commissioners, State of Kansas. ALMERIN GILLETT, ALBERT R. GREENE, JAS. HUMPHREY, Commissioners. 6 x 9 ins., 485 pp., cloth bound. Published by the State.

The above report is for the year ending Dec. 1, 1888, and is of especial interest because of the very unsatisfactory returns which Kansas railways have made to their owners during the past year. The report states that Kansas has 5¼ miles of railway to each thousand of her inhabitants, a larger proportion than exists in any other State of the Union, or indeed in any country in the world. Of the 8,800 miles of railway in the State, 4,091 miles of road did not earn enough in 1888 to pay their operating expenses and fixed charges. The tabular matter in the report occupies 35 pages, and is very well presented.

—A Geological and Topographical Map of the New Boston and Morea Coal Lands in Schuylkill Co., Pa. By BENJ. SMITH LYMAN, 708 Locust St.: Philadelphia, 1889.

This exceedingly detailed map, on a scale of 400 ft. to an inch, shows by plan outcrop, and sections the mammoth coal vein and its immediately neighboring veins. The whole surface is shown in 10-ft. contours, and symbols indicate the strike and dip of the rock, etc. An included map of the railways communicating with this region and New York, Philadelphia, and Baltimore completes this elaborate record of the most important of the coal deposits in the greatest coal field of the world.

Journal of the New England Water-Works Association. March, 1889.—The March number contains the discussions on Mr. SHERMAN'S paper: "What is the Safe Ratio of Pumping Capacity to Maximum Consumption," and the following brief papers: "Remarks on Meter Tests," L. F. RICE; "Protection of Pipes from Frost," E. R. JONES; "Construction and Maintenance of Water-Works," C. W. KINGSLEY; and "Water in Some of its Higher Relations," D. N. BEACH.

BOOK REVIEWS.

A General Formula for the Uniform Flow of Water in Rivers and Other Channels. By E. GANGUILLET and W. R. KUTTER, Engineers in Berne, Switzerland. Translated from the German, with numerous additions, including Tables, Diagrams, and the elements of over 1,200 gaugings of rivers, small channels, and pipes, in English measure, by RUDOLPH HERING and JOHN C. TRAUTWINE, Jr. New York. 1889. John Wiley & Sons, Publishers. Size, 6x9 ins. pp. 240, with folding diagram, etc. Price $4.00.

In translating the Second Edition (1877) of the work

of these two celebrated Swiss engineers, a translation which is officially authorized by the original authors, Messrs. HERING and TRAUTWINE are entirely too modest in setting forth on the title-page the amount of real work performed by them. The present volume is essentially a new work in its usefulness for American and English practice, and is entirely new and extremely valuable in presenting to hydraulic engineers a more extensive and varied list of actual gaugings than was ever before published in any country. The original German edition used has but 123 pages of text and a half-dozen folding diagrams, and its table of gaugings gives the average values of 81 different channels, with fewer elements, and a very scanty description, if any, of the character of the channels. In comparison with this, the present work first faithfully translates the authors' ideas in a review of the present status of our knowledge concerning the laws of flowing water, and in establishing a new formula and showing its close agreement with experimental results obtained under widely different conditions, but in addition to this translation of the original treatise, the editors have added a number of extracts from sundry other works of Mr. KUTTER bearing upon this subject, and still other matter of their own which will increase its general usefulness to hydraulic engineers.

This added matter may be briefly summarized as follows: Simple instructions for constructing the diagram used for a graphical solution of the formula; KUTTER'S modification of BAZIN'S general formula, useful for special purposes on account of its comparative simplicity; formulæ and data concerning the relation between mean and surface velocities in streams; investigations regarding the velocities beyond which a scouring of the bed takes place, in channels of different materials; and HERLACHER'S method of ascertaining the discharge of rivers.

But above all else, the unique feature of 1,200 actual gaugings, with deduced value of the coefficient (n) of roughness of perimeter in English measure, will be invaluable to and most appreciated by all concerned in the flow of water. These extended tables for practical use are divided into Class *A*, of pipes running full under pressure, and Class *B*, referring to open channels and rivers. These gaugings are again subdivided according to the smoothness or roughness of the perimeters, and arranged in the order of slopes or mean radii. The data come from original sources, as far as possible, and the elements given are—the surface width, greatest depth, mean radius, slope, velocity, and coefficients c and n. The Swiss engineers assume that the coefficient n is a constant quantity, and in their publications give only its average value for the gaugings which they quote. But in this extended table it will be seen that n varies slightly for the same channel, whether it has small or large dimensions. In the manner in which the series are arranged this variation is generally found to possess some regularity; and it is, therefore, practicable for any given case to select the coefficient's value most suitable for similar conditions. As the coefficient c is dependent upon the combined effect of slope, mean radius, and roughness of perimeter, it is almost hopeless to attempt any arrangement of data in such manner that satisfactory value of c may be assumed for any given case. But in the formula here considered, the variations of c with slope and mean radius have, to a large degree, been given mathematical expression, and the practical engineer is much better able to exercise his judgment, because he is substantially confined to considerations of the character of the perimeter and configuration of the bed. In the text and in Appendix III., the nature of the coefficient n is fully explained at much greater length than can be even outlined here. Turning to the tables themselves, it may be said that they cover experiments in pipes ranging from 0.076 ft. to 8.58 ft. in diameter, and in glass, tin, lead, earthenware, wood, cast-iron and wrought-iron pipe material, and in new and old pipe. In open channels, these experiments range from the smaller test channels to the Mississippi river; they are given for channels lined with cement, boards, or canvas, brickwork or dressed ashlar masonry, with laths or pebbles held in place, rubble masonry, in earth with masonry side walls, in fairly regular earth channels, and so on to more or less irregular channels, with detritus, vegetation, or other obstructions. In a word, for many cases where extreme accuracy is not essential, this table covers so broad a range of possible conditions that the essential elements sought may be picked out from it with little or no figuring on the part of the investigator. But if he wants to be accurate, these tables are simply invaluable.

Messrs HERING and TRAUTWINE, for their faithful, intelligent, and most painstaking labor in the preparation of this work, richly deserve and will doubtless receive the hearty thanks of every English-speaking hydraulic engineer, for nowhere else can that engineer obtain a like amount of valuable data on this exceedingly important subject.

A Treatise on Hydraulics. By MANSFIELD MERRIMAN New York: John Wiley & Sons, 1889. 800; 331 pp. $3.50.

As may be expected from the pen of Prof. MERRIMAN, this book presents a very lucid exposition of the fundamental principles of hydrostatics and dynamics. It is mainly intended for the use of students in technical schools, and every article has one or more problems appended for solution. But the thorough, and at the same time simple treatment of the numerous subjects and a good table of contents will make it a handy reference book also for the practicing engineer, who has no time to wade through the longer discussions of WEISBACH and other more voluminous writers in order to refresh his memory regarding theories not applied by him every day, and to inform himself upon the latest researches and results of experience. The Venturi water meter, lately proposed by MR. C. HERSCHEL, is already described in the work, together with other matters of recent date. All the essential principles of hydraulics are presented in a well digested and concise form.

After an introduction has stated the main physical properties of water, and a chapter of Hydrostatics has explained the conditions caused by hydraulic pressure, we are given a description of the various phenomena of flowing water, and are finally informed as to the main principles governing the use of water as a power for doing work and as a means for the propulsion of vessels.

No pretence is made to even indicate the practical considerations for the construction of hydraulic works to cover which would require volumes. We find nothing concerning the manner of building canals nor of improving rivers or harbors, and are given but a very scant bit of information about currents and the action of waves and tides.

Nor is the student loaded down with abstruse problems, and such as require the extensive use of calculus, but he is substantially confined to the *a b c* of the principles pertaining to at least 99% of all the hydraulic questions arising in actual practice.

The perusal of a book of this kind, almost entirely comprehensible to the layman, can be urgently recommended to all those who are puzzled by the phenomena of hydraulic pressure and flow, as we do not remember having elsewhere seen these questions more lucidly treated.

The student is frequently given good sound advice; for instance, as to the limits of practical possibilities, the uselessness of calculations implying a higher degree of accuracy than can be obtained in practice, and is told of the importance of grasping the fundamental questions, and of cultivating a systematic and neat method of working out the problems.

Over 100 cuts serve to illustrate the subject, and 25 tables of pressures, heads, coefficients, and results of tests are useful for reference and calculation. The action of pressure and velocity heads and of jets of water are well treated. The flow through orifices and over weirs is fully described, and instructions are given for accurate methods of gauging. Only the best formulæ for their respective purposes are mentioned, and no attempt is made at any historical review of the progress made in any branch of the subject or to state any ideas or formulæ which have since been abandoned.

The chapters on the "Measurement of Water Power" and on the "Dynamic Pressure of Flowing Water" will be found instructive and useful to the student.

The least satisfactory part of the book, on account of its brevity, is the last part referring to hydraulic motors and naval mechanics, which together are given only 47 pages.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—A regular meeting was held March 20; Vice-President A. FTELEY in the chair and a large number of members present. Mr. MACDONALD gave some interesting particulars of the great Forth bridge, in England, and a large number of views of the Forth, Poughkeepsie and Hawkesbury bridges were shown by the stereopticon.

It was stated by Mr. EMERY in regard to the trip to Europe that such a comparatively small number of members had decided to go that a special steamer would not be engaged, and the greater number of the party will sail on the *City of New York*, May 26.

Civil Engineers' Club of Cleveland, O.—At the annual meeting the following officers were elected: President, W. R. WARNER; Vice-President, H. C. THOMPSON; Secretary, J. RITCHIE; Corresponding Secretary, A. H. PORTER; Member of Board of Managers of Association of Engineering Societies, W. H. SEARLES; Treasurer, S. J. BAKER; Librarian, J. L. GOBEILLE.

Engineers' Club of St. Louis.—A regular meeting was held March 6, Mr. ROBERT MOORE in the chair.

Mr. RUSSELL, chairman of the special Committee on Closer Union of Engineering Societies, read the following report, which was afterwards adopted:

"In accordance with instructions, your committee recommends, as a preliminary step towards a closer union of the Association of Engineering Societies, that our members of the board of managers be instructed to submit to the board the following amendment to the articles of association:

"'Amendment I.—In addition to his other duties, the chairman of the board shall act as the chairman for the association, and on notice from any society, through any member of the board, that the society desires the association to pass on any question, he shall put the question to the different societies and receive and declare the vote. He shall also receive the reports of joint committees and submit them to the association. In a vote of the association a society shall be allowed as many votes as it has members of the board.'

"In favor of the adoption of this amendment by the Association, your committee would submit the following:

"'As the association of the engineering societies for the purpose of a joint publication has been so successful, it may well be considered whether its objects could not be extended with additional advantage. With the growth of these societies it has become apparent that the reading of professional papers is but one part of their work, and that there is much to be done in the line of keeping special committees at work on questions of engineering policy, or the broader questions of investigation that cannot be covered by the labor of one man. As the joint publication has done much to increase the efficiency of the societies in the one field of work, it is thought that some concert of action in the other will be equally beneficial.

"Article VI. of our articles of association reads:

"'These articles may be amended by a majority vote of the board of managers and subsequent approval of two thirds of the participating societies.

"We cannot foresee the entire field that would be opened, nor is it necessary to state just what lines of work might be undertaken, but that we may have something definite before us, some of the objects may be suggested.

"First. In relation to engineering practice, the subject of standards furnishes a broad field for co-operative work; every day practice brings up the inconvenience of lack of uniformity, and we see that the introduction of standards of form would be a great help to the profession. The standard screw thread introduced by the Franklin Institute illustrates the value of work in this line. Standard units also demand attention; overlooking the much agitated question of weights and measures, there are still a number of units where a standard might be easily introduced with great convenience to the engineer. The thermal unit furnishes an instance; not to be unnecessarily elaborate, we may simply state as desirable, standard tests of efficiency in engines, boilers and furnaces, standard tests of engineering materials and standard specifications. This association is especially fitted for successful work in these lines in that its membership is not confined to professional engineers, but includes a fair proportion of manufacturers and practical men in a number of fields.

"Second. There are a number of questions requiring a broad investigation both on account of the nature of the subjects and that the results may have authoritative recognition, and committees representing the association could well undertake work in this line.

"The work of the committee of the American society on the preservation of timber, on tests of cement, and on the relation of wheel to rail, are illustrations.

"In some of these investigations we might expect to induce the Government to collect much needed data. The present chief of the United States Signal Service has already signified his willingness to adapt the work of his department to the needs of engineers, so far as he may be able.

"Third. There are times when concerted action on subjects requiring legislation is very desirable. The question of highway bridge reform in Missouri is one that is now being pushed by the Kansas City and St. Louis societies, and the force of such movements would be greatly increased by the closer association. As similar objects for the association we might instance harmony in boiler inspection and building laws and other municipal legislation falling in the province of the engineer. The question of government works, the abatement of the smoke nuisance, and the technical education of railroad employés are also suggested.

S. B. RUSSELL,
J. A. SEDDEN,
J. B. JOHNSON,
} *Committee.*

A paper on "Improving the Channel of the Mississippi" by Mr. WINSLOW ALLDERDICE, was read by Prof. JOHNSON. Mr. ALLDERDICE, while engaged in the naval service, was detailed for duty on the vessel *Wachusett*, which attempted to make the passage up the Mississippi to St. Louis in the spring of 1879. The vessel having grounded, the manner in which she was finally floated led the author to formulate certain suggestions as to the deepening of the channel. Mr. RICHARD S. ELLIOTT explained his plan for deepening the channel by means of water jets under high pressure. Prof. JOHNSON called attention to the success of some experiments made by the U. S. engineers at Horsetail Bar, with crude apparatus of a similar nature

WM. H. BRYAN. *Secretary.*

New England Railroad Club.—The annual meeting was held at the Revere House, Boston, on March 13. An informal reception was held from 5 to 6 o'clock, after which there was a short business meeting for the presentation of the annual report and the election of officers, Vice-President GEORGE RICHARDS occupying the chair in the absence of President LAUDER.

Mr. FRANCIS M. CURTIS presented the Report of the Secretary and Treasurer, from which it appears that the Club now numbers 196 members; that $372 has been collected during the year for membership dues; and that there is a balance on hand of cash in the treasury of $166.58. The report was accepted and adopted.

The Committee previously appointed to nominate officers for the ensuing year reported the following list: For President, GEORGE RICHARDS; Vice President, ORLANDO STEWART; Secretary and Treasurer, FRANCIS M. CURTIS; Executive Committee, GEORGE RICHARDS (Chairman), JAMES N. LAUDER, J. W. MARDEN, OSGOOD BRADLEY, ROBERT JOHNSON, F. D. ADAMS, SAMUEL D. NYE, ALBERT GRIGGS, F. M. TWOMBLY; Finance Committee, CHARLES W. SHERBURNE (Chairman), JAMES SMITH, CARROLL J. POST, JOEL H. HILLS, DANIEL S. PAGE, ISAAC N. KEITH, CHARLES RICHARDSON, A. G. BARBER, JOHN KENT. By vote of the Club, the report was declared accepted, and the gentlemen named elected as officers for the next year.

President RICHARDS announced as the subject for discussion at the next meeting, "Compound Engines," to be opened by Mr. ANGUS SINCLAIR of New York.

The annual dinner was then served, and at its close the President called the members to order, and introduced Hon. GEO. G. CROCKER, Chairman of the Massachusetts State Railway Commission. After some witty remarks Mr. CROCKER told the Club of the action taken by the Joint Convention of Railway Commissioners regarding the introduction of automatic couplers and brakes for freight cars. One-half of all the injuries to employés on railroads last year in the State of Massachusetts were in coupling and uncoupling cars, and about one-third of all the fatal accidents to employés were in falling from the tops of freight cars. The Board feels very strongly upon that subject, that there ought not to be 150 employés per year maimed in Massachusetts, and believes that that number can be very materially decreased.

Remarks were also made by Hon. FREDERICK SMYTHE, Ex-Governor of New Hampshire, WM. MARTIN of the Martin Car Heater Company, CHAS. M. BOLEN, of Newark, N. J., WILLIAM C. TYLER, of the *Railway Review*, F. D. ADAMS of the Executive Committee, President GEO. RICHARDS, Mr. GEO. H. CONEY and others. A tribute was paid to the late JOHN ERICSSON by the last two speakers, and Mr. CONEY gave the following interesting bit of history:

The earliest propellers built in this country were designed by Captain ERICSSON, and I think were placed on the Delaware & Raritan Canal. The first Ericsson propeller built in New England was built by OTIS TUFTS at East Boston, and put upon a steamer called the *R. B. Forbes*. There were twin screws, and the propeller was one in which the blades, instead of being attached to the hub as they are now, were attached to the rim that went round them. Previous to this my father made a contract to build an iron cutter for the United States Revenue service, called the *McLane*. There were six ordered built, and this was one of them. Three of them had the Hunter propeller, and three the Ericsson propeller. The first constructed with the Hunter was the *Spencer*, built in New York; the *Legaree*, with the Ericsson propeller, was also built in New York. Those two vessels were the first to demonstrate the relative value of the Hunter propeller and the Ericsson propeller. The *Spencer* could not go fast enough to get out of her own way; the *Legaree* made very good time on the trial test. Mr. B. F. ISHERWOOD wrote a book about 30 years ago called "Engineering Precedents" and he based all his opinions and calculations upon the trials of these two steamers. The Hunter propellers were all abandoned, and my father changed the *McLane* to a side-wheel steamer. His name was JABEZ CONEY. He also built the U. S. Steamer *Saranac*.

After various other speeches, recitations, etc., the company dispersed.

Western Railway Club.—At the meeting of this Chicago club on March 19, the subjects for discussion were "Draw-Bar Rigging" and "Axles for 60,000-pound Cars."

WALTER D. CROSMAN, *Secretary.*

New England Water-Works Association.—At the quarterly meeting at Young's hotel, Boston, March 13, after the business transactions mentioned in our last issue, Mayor JACKSON, of Fall River, gave an address on the "Relation of Great Ponds to our Water Supplies." The legal and legislative aspect of the subject was the one considered by Mayor JACKSON, he stating that in 1641 and 1647 the legislative body of the Massachusetts Colony passed an ordinance to the effect that all great ponds should be in common. Further legislation, and court decisions have sustained and enlarged upon these early ordinances, until now all ponds with an area of more than 10 acres are held as common public property. The first rights secured to the common public, were for fishing and hunting on these ponds, and cutting ice from them. Later, mill-rights were granted until now one-half the great ponds of Massachusetts are increased in size by dams at their outlets.

With the displacement of water by steam-power, and the growth of towns and their demand for a public water supply, the Legislature has granted indiscriminate rights to cities and companies to take water from these large ponds, with the provision that damages be paid.

A suit has recently been brought against the Watuppa Water Board of Fall River, by mill owners, for damages to them arising from the taking of water from ponds for the City's supply. The suit was carried to the Supreme Court, which decided that the city must pay the damages. Therefore the Watuppa Water Board appealed to the Legislature, urging it to take the view that the common right in great ponds was applicable to taking water from them for domestic purposes, as well as to using them for fishing, hunting, bathing, cutting ice and milling, and, moreover, that the decline in the use of water-power has been so great that it is now of more importance to the general public that water be secured to cities for domestic use, without damages, than to private mill owners. The Legislature finally passed over the Governor's veto a bill embodying these principles. The whole question, said Mayor JACKSON, resolves itself into domestic and sanitary needs of the public for water against the needs of mill owners for water for power. A new bill is now before a committee, and if it passes, whoever, whether mill owner or city, obtains rights to a stream will have the full supply.

The paper was discussed by W. M. HAWES, Fall River; L. FRED RICE and DESMOND FITZGERALD, Boston; and H. G. HOLDEN, Nashua. The most important suggestion brought out in the discussion was that in granting these rights there ought to be a distinction as to who supplies water to people from these ponds, whether city governments or water companies. The idea was also conveyed that in case mill owners would be damaged they should be paid, but that they should not claim exclusive right to all the water of a stream, below a certain level.

The Superintendent of the Springfield Water-Works, J. C. HANCOCK, read a short paper regarding the proper size for a new main from the Ludlow reservoir to the city, asking the members of the Association to make suggestions, and giving each a statement of the facts and a stamped envelope for mailing to him their views. The reservoir is 11 miles from the city, 182 ft. above its highest levels, and 312 ft. above its lowest levels. The present main is a 24-in. wrought-iron and cement pipe, with a daily capacity of 7,200,000 galls., while the average daily consumption is about 4,000,000 galls.

A short paper was next read by J. A. TILDEN, Boston, for JNO. WHITELAW, Superintendent, Cleveland (O.,) Water-Works, on a break in a 10-in. submerged main, laid 6 ft. below the bed of the river. General remarks were made by E. R. JONES, Boston, Superintendent of the Eastern division of the Cochituate pipe line.

There was a short discussion on the durability of pipe, joined in by SOLON M. ALLIS, Malden, President NEVONS, EDWIN DARLING, Pawtucket, DESMOND FITZGERALD, Boston, and Mr. SANDERSON. A paper on "Lowering Water Mains", was read by DEXTER BRACKETT, Boston, and remarks on "The Croton Aqueduct" made by DESMOND FITZGERALD, Boston. The latter mentioned the very satisfactory use of grout in repairing the defective work on the aqueduct.

A paper was read by the Secretary of the Association, R. C. P. COGGESHALL, on the "Construction of the Gate House at the Acushet Reservoir," New Bedford.

Some papers having been sent in by members who could not attend the meeting, these were read by DEXTER BRACKETT, Boston, one having been written by W. A. RICHARDS, New London, and another by CHAS. A. ALLEN, Worcester. The former was on an "Accident to a Tile Conduit," wooden wedges being successfully used for temporary repairs.

After a vote of thanks to Mayor JACKSON, of Fall River, for his remarks, and some pleasantries, the meeting adjourned till June, on motion of A. G. GLOVER, West Newton.

The Convention of the State Railway Commissions with the Interstate Commerce Commission.

(*Concluded from page 246.*)

After calling on the President, the convention assembled at 10 A. M., on March 7, for the final session. Some discussion took place concerning the place for holding the next convention, and invitations were extended from Lincoln, Neb., and St. Augustine, Fla. Commissioner KINSLEY, of Massachusetts, opposed these suggestions and said that Washington was the proper place for holding any future conventions. Mr. BONHAM, of South Carolina, spoke briefly on the desirability of legislation to decide the relative jurisdiction of the State and Interstate Commissions. Mr. AGER, of Nebraska, introduced the question of what constitutes a reasonable rate. Chairman COOLEY said:

We have had a great many people before us who were interested in presenting the question of the reasonableness of rates on both sides. We have invariably found that they presented the question with a special regard to their own interests. Many commercial bodies have presented papers to us, and able papers, from their standpoint; but invariably they have discussed the question in a very narrow way,—I mean narrow as regards the whole scope of railroad transportation,—so that, except for the particular case, they seldom have been of any advantage to the Commission.

Investigation of railway accidents by the State Commissions was brought up by Mr. FLEMING, of Kentucky. Commissioner RICH said that in Michigan all accidents involving fatality are reported to the Commission and to the Coroner. In a general way, he thought the law made railway officers and employés more careful than they otherwise would be and that it met with general approval. Similar statements were made with reference to the working of the law in South Carolina and Connecticut.

Chairman SPAULDING, of the Committee on Uniform Statistics, reported the changes recommended in the proposed form for annual reports. A discussion arose over the question whether "Materials and Supplies on hand" should be classed under the head of "Cash and Current Assets" available for payment of current liabilities. Messrs. WALKER and ADAMS, of the Interstate Commission, and Mr. KIRKMAN, President of the Association of Railway Accounting Officers, presented very forcibly the reasons why this change should not be made, and the Convention voted in accordance with their views.

The question of inserting the words "save for errors" in the oath certifying to the correctness of the reports required from railway accounting officers was then taken up. After some discussion, it was voted to leave the form of the oath to be decided by the Interstate Commerce Commission.

It was voted that copies of the uniform blank for annual reports be furnished at once to the railway accounting officers and the various State Commissions.

A resolution was adopted thanking the Interstate Commission and the officers of the Convention for the courtesies extended, and Chairman COOLEY expressed his gratification at the cordial response which the State Commissions had made to the invitation. The final adjournment was then taken.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Long Island.—The contractors are still at work on the extension from Locust Valley to Oyster Bay, about 4 miles, and trains will probably not be running before Sept. 1. The extension will cost about $50,000 per mile.

Lake Erie, Alliance & Southern.—The proposed 11-mile extension from Canton to Paris, O., in which ANDREW CARNEGIE is interested, is noted upon our Engineering News page.

Canadian Pacific.—It is believed that the company intends to run its trains into Buffalo, N. Y., at an early day. Right of way from Niagara Falls to Buffalo is said to be all secured. The Niagara Central railway will be built from Toronto to the Niagara river, and a bridge will be built at some point connecting with the proposed line to Buffalo.——Work trains will be put on the International road in Maine about April 15 to complete the ballasting and surfacing.

Grand Trunk.—This company has an application before the Railway Committee of the Privy Council for permission to build a short line near Hamilton to connect the Great Western and the Northern & Northwestern divisions.

Middletown & Hummelstown.—The contract for building this Pennsylvania road has been awarded to H. H. Bechtel & Co. The line is 6 miles in length. The general offices of the company are at Middletown, Pa.

Cincinnati, Wheeling & New York.—Negotiations are reported in progress for the construction of extensions of this Ohio road from Morgan Junction to Freeport and from Cumberland to McConnellsville. J. W. CAMPBELL, Cambridge, O., is Receiver and General Manager.

Evansville & Richmond.—It is announced that this Indiana road will not run through Columbus, as originally intended, but will be built from Seymour to Madison or Greensburg.

Baltimore & Ohio.—Surveys are nearly finished for the Schuylkill Junction R. R. which is to furnish a direct connection between the Baltimore & Ohio and Philadelphia & Reading tracks at Philadelphia. Right of way for the road is now being obtained.

New York, Susquehanna & Western.—It is reported that this road, extending from Jersey City across northern New Jersey to Stroudsburg, Pa., is to form part of the Pennsylvania system, will be used by that company as an outlet to the Poughkeepsie bridge, and will be extended from its present terminus to Scranton, Pa.

Boston & Albany.—The bill to increase the capital stock of this company, and permit the present stockholders to subscribe for it at par is being vigorously opposed in the Massachusetts Legislature. It is contended that the present bill really permits a fat stock dividend to the present owners of the road; and that if new stock is to be issued, it should be sold to the highest bidder.

Delaware & Hudson Canal Co.—It is stated that a branch will be built in the spring from Carbondale to Jefferson Jc., Pa., 32 miles.

Wheeling & Lake Erie.—Subscriptions to the amount of $35,000 have been made at Steubenville, O., to induce the company to build a branch to the Ohio river at that point. If $15,000 more is raised, the branch will be built. ——It is reported on good authority that the company was anxious to purchase the Valley Ry., of Ohio, and offered $300,000 for a controlling interest in it. The managers were much disappointed to learn that the CARNEGIE syndicate had secured the road.

Leamington & St. Clair.—This road, extending from Leamington to Comber, Ont., 15 miles, has been sold to the Michigan Central. The new owners took possession on March 15.

Brockville, Westport & Sault Ste. Marie.—The Dominion Government is to grant this company a subsidy of $150,000 to aid the extension from Westport to Palmer's Rapids in Renfrew county, Ont.

Lehigh Valley.—Surveyors are at work on the Buffalo & Geneva Railroad between Le Roy and Caledonia, N. Y.

Battle Creek & Bay City.—Receiver W. A. ACKERMAN has appointed W. IRVING FOX, General Superintendent of this road and of the St. Louis, Sturgis & Battle Creek Ry., in Michigan.

Pennsylvania.—The Tyrone Clearfield railroad is being extended from Curwensville to new mines on the north branch of the Susquehanna.——The low grade line on the West Pennsylvania railway is being extended from Bolivar to Johnstown, Pa., about 20 miles. The line parallels the main line, but lies about 300 ft. lower on the opposite bank of the Conemaugh river. The line is used for freight traffic exclusively. The cost of the extension will be about $350,000.

Schuylkill & Lehigh—The contractors for building this Pennsylvania road, in the Pottsville coal basin have begun work on the grading. The line follows the graded roadbed of the old Lizard Creek railway and it will require but little labor to prepare it for the track on a large part of the line. The Anthracite Improvement Co. has been organized in connection with the new railway and has secured large coal tracts near the line of the road. It is generally conceded that the new line will be operated in the interest of the Lehigh Valley Co.

Lake Erie & Western.—The annual report shows the following results:

	1888.	1887.
Gross expenses	$2,167,790	$2,087,330
Operating expenses	1,357,848	1,280,503
Net earnings	$809,940	$806,827
Fixed charges	397,878	
Surplus	412,061	

Net earnings to the extent of $423,795 were spent in improvements.

Jones' Mountain.—This short road, extending from Clapp & Jones factory to Becraft's Mountain, near Hudson, N. Y., was formally opened on March 16.

Niagara Central.—A deputation from St. Catherines, Ont., recently visited Toronto to see what aid could be obtained for the proposed extension to Toronto. It was agreed to send a deputation to Ottawa to ask the aid of the Government for the work.

Projects and Surveys.

Charleston & Jeffersonville.—It is stated that the project to build a narrow-gauge railway from Charleston, Ind., to Jeffersonville, Ind., mentioned in our issue of Feb. 2, 1889, has been abandoned.

Delaware & New England.—A bill is before the Delaware Legislature to incorporate a company by this name. Their object is to secure a continuous rail route from Delaware to New England by consolidating the various lines of road being built to connect with the Poughkeepsie bridge. The route will be from Dover Del., over the Pennsylvania R. R. to Trenton, N. J., thence via Easton, Pa., to Poughkeepsie, N. Y. Among the incorporators are HENRY MCCORMICK, STEPHEN A. CALDWELL, JOHN S. WILSON and CHARLEMAGNE TOWER, Jr.

Hancock & State Line.—Incorporated in New York, to build a line of railway from Hancock on the line of the New York, Ontario & Western Ry., southeast to the Pennsylvania State line, a distance of 3 miles. Among the incorporators are JOHN B. KERR, JOHN BURTON, J. E. CHILDS, of New York, and M. D. WHEELER, of Hancock, N. Y.

Geneva & Van Ettenville.—JOSEPH S. LEWIS, of Geneva, N. Y.; J. W. BISHOP, of Sayre, Pa.; DANIEL R. PRATT, of Elmira, N. Y., and others have applied for a charter to build a line of railway from a point near Geneva, N. Y., to a point on the Geneva, Ithaca & Sayre R. R. near Van Ettenville station, a distance of about 60 miles.

Chesapeake, Ohio & Southwestern.—A charter has been procured for the extension of the Elizabethtown & Hodgdenville branch to Buffalo, Ky., a distance of 5 miles. The company has offered to build the extension if the people along the line will do the grading.

Gainesville & Dahlonega.—RENNEAU & GAILLARD, of Atlanta, are making surveys for the extension from Dahlonega, Ga., to Leather's Ford, to reach iron ore deposits.

Chesapeake & Nashville.—A dispatch from Harrodsburg, Ky., states that THOS. MCMICHAEL has begun surveys between Harrodsburg and Lebanon.

West Virginia Central & Pittsburg.—It is announced that within 60 days a force of from 500 to 1,000 hands will begin grading on the extension to Charleston, W. Va., 120 miles from the present terminus.

McKeesport Connecting.—Chartered in Pennsylvania to build a railway four miles in length from McKeesport to Port Perry, Allegheny county, a distance of four miles.

Staten Island Beach.—Incorporated in New York to build a railway from Edgewater, Staten Island, to New Dorp, 3 miles, by JOHN SCOTT, REUBEN LORD, NATHANIEL MARSH and others of Edgewater.

Add to Southern Ex Roads.

Louisville & Nashville,—The citizens of Pine Apple, Ala., have offered to grade the extension from the present terminus to Pine Apple, a distance of two miles, if the company will lay the track.——The citizens of Tuscaloosa, Ala., have sent a committee to inquire what bonus will be required to induce the company to build an extension to that point.

Cleveland & Chicago.—It is stated that a company is about to be incorporated in Ohio, to build a line of railway from Fremont to Napoleon, about 53 miles, with a possible extension from Fremont east via Berlin Heights, Middleburg, Parma, Cleveland, Chardon, Linesville to a connection with the Philadelphia & Reading R. R. That portion of the line between Fremont and Napoleon will be built during the coming summer, and if satisfactory, connections can be made with existing roads, the remainder of the line will not be constructed for some time. But if such arrangements cannot be made, the entire line will be built at once. Ex-President R. B. HAYES, and W. J. HILAND and ISAAS REYNOLDS, of Cleveland, O., are interested.

Manitoulin & North Shore,—The Ontario Legislature has granted this company, which proposes to build a line of railway from the village of Little Current to a point on the Canadian Pacific Ry. in the township of Nairn, a distance of 28 miles, a cash subsidy of $3,000 per mile.

Parry Sound Colonization.—This company has been granted a cash subsidy of $3,000 per mile, by the Ontario Legislature, for their proposed road, which is to run from the town of Parry Sound to Burk's Falls, a distance of 40 miles.

Delaware River & Lancaster.—It is stated that engineers are at work on a re-survey of this road, which is projected to run from Lancaster, Pa. to Phœnixville, Pa., about 40 miles.

Lehigh & Eastern.—The franchise, right-of-way and partially graded road-bed of this company was sold at auction on March 16 at Wilkesbarre, Pa., and was bought by SILAS W. NEWBURGER, of New York City, for $190,000 Since the sale S. P. and J. H. KASE of New York have brought suit to set aside the sale.

New York & Connecticut Air Line.—The Railroad Committee of the Connecticut Legislature had a hearing this week of the petitioners who wish an extension of the time in which the company may construct its road. A. P. HYDE, of Hartford, appeared for the petitioners. He stated that arrangements had been completed with the New York & Boston Rapid Transit Company by which the road would form part of a through air line from Boston to New York City, the construction of which was now certain, provided the extension of time was granted. Hon. L. E. CHITTENDEN, counsel for the New York & Boston Rapid Transit Company, also urged the granting of the petition. The petition was opposed by H. C. ROBINSON, counsel for the New York, New Haven & Hartford.

SOUTHERN—Existing Roads.

Orange Belt.—Grading is finished for the extension to Sanford, Fla.

High Point, Randleman, Asheboro & Southern.—The contract for the tracklaying on this North Carolina road has been awarded to the Greystone Granite Construction Co., of Henderson. JOHN H. WINDER is the Business Manager.

Chattanooga Belt.—Tracklaying is in progress on the extension to Sherman Heights.

Louisville, New Orleans & Texas.—J. S. McTighe & Co., the contractors for the Bolivar branch, expect to begin grading before the close of the month.

Virginia Western.—It is said that a contract for a 10-mile section of this road, the Virginia division of the Tennessee Midland R. R., has been let to D. S. Pitzer. H. D. WHITCOMB, Richmond, Va., is Chief Engineer.

Charleston, Cincinnati & Chicago.—McDonald, Shea & Co., the contractors who are building the 250 mile link from Asheville, N. C., to White House, Ky., will concentrate their forces on the division between Minneapolis, Tenn., and the East Tennessee, Virginia & Georgia railway, in order to furnish an outlet as soon as possible to valuable coal deposits.

Norfolk & Western.—The track will be laid to Pounding Mill station, 31 miles west of Graham, by April 1. Cedar Bluff, which is expected to be reached by the tracklayers by July 1, is 35 miles west of Graham and not 30 miles as stated last week.

Columbus Southern.—About half the grading is finished on this line, extending from Columbus to Albany, Ga., 87 miles, and tracklaying is to begin soon. James W. English, of Atlanta, is the contractor and W. S. GREENE, of Columbus, is Chief Engineer.

Chesapeake & Ohio.—A short branch, 2½ miles in length, is under construction to Riverview, W. Va., by C. D. Langhorne. Other short branches to tap coal mines adjacent to the line are contemplated.

Ohio Valley.—It is expected that the extension from Henderson, Ky., to Evansville, Ind., will be in operation early next month.——As soon as this is completed, work is to be undertaken on the Hopkinsville extension.

Projects and Surveys.

Hartsville.—We have received the following information from J. L. COKER, of Hartsville, S. C., President.

The surveys for this road, which is projected to run from Hartsville to a connection with the Cheraw & Darlington R. R., a distance of 10 miles, have been made. The route is through a level country. The principal business of the road will be in the transportation of cotton, lumber, fertilizers and farm produce. Nearly all of the right of way, and other local aid sufficient to grade the road, has been secured. It is expected that tracklaying will begin in about 60 days and the road be opened for traffic by September.

Chattanooga Southern.—It is stated that arrangements have been made to place $400,000 of bonds for the immediate building of this road from Chattanooga, Tenn., to M'Lemore's Cove, about 30 miles. The road is projected to run from Chattanooga to Atalla, Ala., 84 miles. W. CRUTCHFIELD, of Chattanooga, is President.

West Virginia & Pennsylvania.—Incorporated in West Virginia to build a line of railway from a point at or near Rowlesburg, Preston County, W. Va., north along the east bank of the Cheat River to the Pennsylvania State line, about 27 miles. The principal offices will be at Kingwood, W. Va. Among the incorporators are GEO. W. L. MARSDEN, of Philadelphia, and W. M. O. DAWSON and NEIL J. FORTNEY, of Kingwood.

West Virginia, Pineville & Tennessee.—It is reported that the preliminary surveys for this road, which is projected to run from the Breaks of Sandy to the Tennessee State line, via Pineville, W. Va., have been completed. H. V. LOVING, of Pineville, is President.

Davisville.—The Tallapoosa Furnace Co., of Tallapoosa, Ga., contemplate the building of a railway to their ore mines at Davisville, Ala.

Jacksonville, Williamsport & Anniston.—A press report states that this company will build a 20-mile railway. The road is to be finished by Sept 1, 1889. JAS. CROOK is President, and J. A. GABOURY, of Jacksonville, Ala., is General Manager.

Charlotte & Goldsboro.—A bill is before the North Carolina Legislature to incorporate a railway company by this name.

Atlantic, Cincinnati & Alabama.—This company has been formed by a consolidation of the Cincinnati, Huntsville & Birmingham, the Cincinnati & Birmingham, and the Atlantic, Cincinnati & Alabama companies. The city of Huntsville, Ala., has subscribed for $40,000 worth of stock, and it is stated that work on the road will begin very soon.

Louisville, Hardinsburg & Western.—This Kentucky road is projected to extend from Louisville west to a point in Christian county. Col. J. C. FAWCETT, of Louisville, the builder of the Louisville, St. Louis & Texas road, is the projector of the line. Surveys are in progress and grading is to begin at an early date.

Selma & Cahaba Valley.—This project to build a railway from Selma to Bessemer, a distance of 75 miles, is again being agitated. R. M. NELSON, of Selma, Ala., is President.

Winona & Vicksburg.—A project is on foot to build a railway from Vicksburg, Miss., to Winona, Miss., a distance of about 100 miles. B. I. WARD, W. N. HART, and others, of Winona, are interested

THE NORTHWEST—Existing Roads.

Chicago, Burlington & Quincy.—The annual report of this company just issued gives the following results:

	1888	Decrease from 1887.
Gross earnings	$23,780,167	$3,786,910
Operating expenses and taxes	18,882 459	I. 2,784,546
Net earnings	4,906,708	6,571,457
Total net earnings (adding interest, exchange, etc)	5,076,309	7,290,910
Fixed charges	5,906,712	I. 710,628
Dividends	3,819,578	2,291,486
Miles operated	4,917	I. 222.24

The report says:

After many prosperous years the Chicago, Burlington & Quincy Co. has experienced a year of serious reverses. After paying fixed charges, including $700,000 contributed to sinking funds, and dividing 5 per cent. upon the stock, the accounts show a deficiency for the year of $4,831,425, which it has been necessary to take from the accumulated surplus of the company. Chief among the causes of the

falling off in the net revenue from the operations of the road was the strike in February. This was not the only cause, however. There has been a diversion of traffic to other roads and a decline in rates. The decline in rates has been due to the difficulty of self-regulation among the railroads without the right to pool, which was taken away by the interstate commerce law.

The increase in expenses during the year is due partly to the fact that we have operated an average of 4,859 miles, as against 4,239 in 1887, the new mileage being unproductive. A large part of the increase in expenses is due to the strike of the 2,500 trained men which destroyed a large part of the great machine, the task of reconstructing which had to be undertaken and performed without allowing the machine to stop or become impaired. This involved, and still involves, extra expense. To make the present force equal to the old in all respects is merely a question of time.

President PERKINS goes over the relations of the Chicago, Burlington & Quincy to the Chicago, Burlington & Northern, and shows that the former now holds 30,970 shares out of the 90,975 shares of the stock of the latter.

Milwaukee, Lake Shore & Western.—The company has secured right of way through the Flambeau Indian reservation in Wisconsin, and will at once complete the link from Rhinelander to Hurley. This will considerably shorten the route between the Gogebic mines and Milwaukee.

Winona & Southwestern.—The final settlement with Donald Grant, Foley Bros., and E. C. Long & Co., the contractors who built the first 20 miles of this road, has finally been made. $200,000 in bonds were turned over to the contractors to extinguish their claims.——C. E. M. MORSE has finished the locating survey between Marion and St. Charles, and C. F. B. HASKELL is locating the temporary track from Bear Creek to the main line, which will be used for transporting material while work on the tunnel is in progress.

Illinois Central.—The proceedings at the annual meeting were enlivened by the presence of Messrs. F. B. COOLEY and D. B. HOWE, of Hartford, Conn., representing certain Eastern stockholders who propose to have a voice in the management of the property. President FISH stated in reply to Mr. COOLEY'S question that the reports of proposed extensions from Madison, Wis., to Lake Superior, and from Sioux City, Ia., to Ogden, Utah, were without foundation. Mr. MASON offered a resolution that no extensions, branch lines, or feeders should be built or leased by the company during 1889. President FISH opposed this and declared that it reflected on the veracity and good faith of the company's managers. An amendment was offered excepting those lines on which construction is already commenced or for which leases have already been negotiated, and in this form the resolution was passed.

Cairo, Vincennes & Chicago.—The report is confirmed that this Illinois road is to form part of the new "Big Four" and "Bee Line" system.

Kansas City, Wyandotte & Northwestern.—The Board of Trade of Beatrice, Neb., have appointed a committee to confer with General Manager SUMMERFIELD regarding a right of way for the entrance to Beatrice. The distance from the present terminus to Beatrice is about 20 miles.

Winnipeg & Hudson Bay.—Considerable dissatisfaction is expressed with the recent action of the Manitoba Government in cutting down the Government guarantee on this road to a point which practically buries the project. There is a strong suspicion, however, that the agitation is more for political effect than from any real desire to pledge the credit of the Government in aid of the unwieldy enterprise.

Northern Pacific & Manitoba.—The railway committee of the Dominion Parliament has reported favorably the bill granting a charter to this company.

St. Paul, Minneapolis & Manitoba.—It is reported that the rapid work on the Duluth & Winnipeg has aroused President HILL, and that he has gone East to float a loan of $5,000,000 which will be used to construct a line from Crookston to Duluth parallel to the proposed route of the Duluth & Winnipeg. A portion of the line, 46½ miles in length, was built last year; and a large amount of surveying has already been done on the remaining portions. It is probable that work will be pushed as soon as the season opens.

Projects and Surveys.

Paxton & Eastern Illinois.—Incorporated in Illinois to build a line of railway from Paxton, Ford county, Ill. to a point on the boundary line between the States of Indiana and Illinois north of the line of the Toledo, Peoria & Warsaw R. R. The principal offices will be at Paxton. The incorporators are CHAS. BOGARDUS, RANDOLPH CRUZEN, J. P. MEDDLECOFF, SAMUEL L. DAY, and JOHN H. MOFFETT, all of Paxton.

Ontario & Rainy River.—The Ontario Legislature has granted this company, which proposes to build a railway from Port Arthur west via Fort William, a distance of 50 miles, a cash subsidy of $3,000 per mile.

Black River Falls & Eastern.—Incorporated in Wisconsin to build a line of railway from Black River Falls via Alva to a point on the Green Bay, Winona & St. Paul R. R. between City Point and Tremont, a distance of 25 miles. Among the incorporators are HUGH H. PRICE, DUDLEY J. SPAULDING, WARREN C. JONES, and others. The principal offices will be at Black River Falls, Wis.

THE SOUTHWEST—Existing Roads.

Cleveland, St. Louis & Kansas City.—The sub-contract for the foundations of the Alton bridge has been relet, and the work is now expected to go forward without delay. The contractors on the grading between St. Charles and Boonville are making good progress.

Wabash Western.—The annual meeting was held at St. Louis, March 12. The annual report shows as follows:

	1888	*Decrease from 1887*
Gross earnings	$5,779,583	$738,478
Operating expenses	4,386,391	281,732
Net earnings	1,381,191	456,787

The average freight rate per ton mile was 0.798 cts. against 0.904 cts. in 1887. The average passenger rate per mile decreased from 2.223 cts. in 1887 to 2.079 cts. in 1888.

Denison & Wachita Valley.—About 5 miles of track have been laid on this road, which is to run from Denison, Tex., to Forth Smith, Ark., and it is expected that 15 miles will be finished by May 1. B. D. Corder and Dodson & Sturman are the contractors for grading and Weed & Bradburn the contractors for the tracklaying. H. W. Fox of Denison, Tex., is Chief Engineer

San Antonio & Aransas Pass.—Grading is finished on an 8-mile extension from Shiner to Gonzales, Tex.——It is said that the strike of the tracklayers on the Houston extension was on account of the delay in giving them their wages, owing to temporary lack of funds.——Grading is to begin March 25 on the extension from Comfort to Llano, 75 miles, for which a bonus of $125,000 has just been secured.

Projects and Surveys.

Baton Rouge, Ponchatoula & Mobile.—Organized in Louisiana to build a line of railway from Baton Rouge via Ponchatoula to the Mississippi State line, about 95 miles. C. S. BURT is President, E. J. MARSH Vice President and ANGELO R. BURT, Secretary.

Dallas, Pacific & Southeastern.—It is stated that the contract to build the first 85 miles of this road has been let to Burkett, Burns & Co., of Palestine, Tex. The road is projected to run from New Orleans via Dallas, Tex., to the Pacific Coast. J. E. HENDERSON, of Dallas, is President.

Helena, Pine Bluff & Shreveport.—Surveys are in progress for a railway between Helena and Pine Bluff, Ark., about 86 miles.

ROCKY MT. AND PAC.—Existing Roads.

Northern Pacific.—The controversy over the right of way through Jefferson canon in Montana, which has been so magnified in the newspaper reports, has been amicably settled. The company has purchased of the Union Pacific its abandoned grade through the canon, and will push work at once on an extension from Gallatin, a point on the main line 69 miles south of Helena, to Butte City. The new line will be about 50 miles in length and will shorten the distance from Butte to the eastern markets over the Northern Pacific about 100 miles. It will also furnish a short route for shipments of coal from the new mines in the Rocky Fork district to the Butte settlers.——Engineers are said to be making surveys for a line from the Castle mining district to Neihart, Montana. It is thought that their work indicates a contemplated line from Billings to Great Falls to connect with the new road from the International boundary south to Fort Benton.——A delegation has been sent by the Board of Trade of Ellensburg, W. T., to confer with President OAKES regarding the proposed railway from Ellensburg to the Columbia river.——A very heavy emigrant traffic is now being carried over the line, most of it bound for Tacoma, and other points in Washington Territory.

Union Pacific.—A short extension is to be built from Silver City, Utah, to Eureka Hill.——Reports in circulation at Salt Lake City indicate that grading will begin on the Utah Southern extension within 30 days. It is said that ROBERT BLICKENSDERFER will be the Engineer in-charge of the extension. The surveying parties are still at work on the line through northern California.

Salt Lake, Nevada & California.—The contractors for grading on this Utah road are JOHN POWELL, of Salt Lake City, and A. ADAMSON, of Lake Point, Utah. Work is already in progress and will be completed by June 15.

Colorado Midland.—It is stated that contracts are to be let at once for the extension from Glenwood Springs, Col., to Grand Junction, 100 miles. Surveys are already in progress.

Southern Pacific.—The locating surveys have been completed for the extension from Santa Margarita to San Luis Obispo. The line crosses the Coast range; and besides the long tunnel, there is much work which will be difficult and expensive. Work on this line is to begin at once. The growth of traffic on the system is well shown in the following table, giving the results of the January operations in 1886, 1888, and 1889:

	1886.	1888.	1889.
Pacific System			
Gross earnings	$1,273,442	$1,648,869	$2,512,672
Operating expenses	784,778	1,221,457	1,931,249
Net earnings	488,664	627,406	681,422
Atlantic System			
Gross earnings	734,978	742,197	1,092,100
Operating expenses	516,474	585,016	713,492
Net earnings	218,504	157,181	288,608
Total net earnings	$707,168	$784,587	$969,030

Oregon & Washington Territory.—On the Dayton extension, the locating party under Engineer ADAMS is at work near Dixie, and the cross-sectioning party under Engineer HUTCHINSON is following close after them. A party under M. C. SHAW have begun a preliminary survey for a line from Walla Walla, W. T., to the Grande Ronde valley via Mill creek cañon and the Blue mountains.

Seattle, Lake Shore & Eastern.—It is proposed that the citizens of Seattle, W. T., subscribe for the bonds of this company to the amount of $800,000, which will enable the extension from Seattle north to the International boundary, to connect with the Canadian Pacific, to be pushed through at once. The matter is under discussion by the Seattle Chamber of Commerce.

Ft. Worth & Denver City.—The contract for a short extension up Long's canon near Trinidad, Col., has been let to J. R. DeRemer.

New Westminster Southern.—The citizens of Whatcom, W. T., have subscribed $50,000 to this enterprise. The report that the company has sold out to the Northern Pacific is denied.

Projects and Surveys.

Tacoma, Olympia & Chehalis Valley.—The surveyors of this road, which is to run from Tacoma, W. T., to Montesano, W. Ter., a distance of about 60 miles, have reached Alena on their way toward Montesano.

Conejos & Antonito.—A project is on foot to build a railway from Antonito, Col., to Conejos, Col., a distance of about 2 miles. Hon. JOHN W. HUGHES, Judge GIRARD AUSTIN and Judge J. M. ARCHULETA are at the head of the enterprise.

Aspen Mountain.—Incorporated in Colorado to build a tram road from a point near Aspen up Spar Gulch to Tourtelotte park. Among the incorporators are D. N. VANHOEVENBERGH, H. T. TISSINGTON, H. B. GILLESPIE and H. J. MAYHAM.

Montana & Canada.—The Galt railway scheme has assumed a definite shape in the incorporation of the above company in Montana by OTIS R. ALLEN, H. D. HAUSER, GEO. A. HILL, and others. This road is to run from Helena to a point on the International boundary about 10 miles west of the West Butte of the Sweet Grass Hills, a distance of about 180 miles. The Fort Benton Construction Co. has been organized at Fort Benton to build the road. Among the directors are A. T. GALT, R. W. CAMERON, W. M. RUMSEY, and others, of Fort Benton, Mont.

Columbia Valley & Eastern.—This company which proposes to build a railway from some point on the Columbia river between Kalama and Columbus, W. Ter., east to a point near Colville, W. Ter., has organized with the following officers: President, R. O. DUNBAR; Vice-President, E. B. WISE; Treasurer, WM. CUMMING, and Secretary C. S. REINHART.

Tacoma, Ellensburg & Conconnully.—It is stated that the funds necessary for the construction of this road, projected to run from Ellensburg, W. Ter., to Port Eaton, W. Ter., a distance of 34 miles, have been obtained. THOMAS L. NIXON, of Tacoma, W. Ter., is Chief Engineer.

Spokane Falls & Missoula.—Incorporated in Washington Territory to build a line of railway from Spokane Falls, W. Ter., to Missoula, Mont., with branches from the main line to Chloride and Webber.

Idaho Transit.—This company contemplates building a railway from Camas prairie and Lewiston, Idaho, to a connection with the Spokane & Palouse R. R.

FOREIGN.

Argentine Republic.—The Villa Maria & Rufino Ry. Co. is floating its shares in London. The proposed line is 140¼ miles in length, extending from Villa Maria to Rufino via Villa Nueva and Carlotta, in the province of Cordoba. The Government has granted the company a concession under which the company is guaranteed an income of 6 per cent. for 11 years on $18,000 per kilometre of road constructed. Contracts for the construction have been let to Geo. E. Church. JAS. CLEMINSON, M. I. C. E., Chief Engineer.

Turkey.—The Ottoman railway, from Smyrna to Aidin, is marketing a bond issue of £600,000 in London for the purpose of building an extension from Serai-keny to Diner, 84 miles, with branches to Ishikji, 27 miles, and to Denzli, 8 miles; and also an extension of the Vireh branch to Odemish, 16 miles. EDWARD PURSER, Winchester House, 50 Old Broad St., London, is General Manager and Chief Engineer.

RAPID TRANSIT.

Dummy Lines.—***Knoxville, Tenn.***—The East End Ry. Co. has been organized by J. C. J. WILLIAMS, M. E. THOMPSON, and T. C. BEAMON to build a dummy line to Ruggies' Ferry.

Rome, Ga.—Arrangements have been made for the construction of the Rome, Kartah & Subligna line projected by Dr. J. T. ROAN.

Birmingham, Ala.—The Birmingham, Powderly & Bessemer Ry. Co. will hold a meeting April 8 to vote upon the issue of bonds for $100,000 for building the road.

Gadsden, Ala.—The Gadsden Land & Improvement Co. will extend its dummy line.

Denver, Col.—The Capitol Hill & Harmon Ry. Co. has been incorporated by H. B. CHAMBERLIN, G. O. SCOTT, and others to build a dummy line 6 miles long. Capital stock, $50,000.

Port Townsend, Wash. Ty.—The Port Townsend Irondale & Hadlock Ry. Co. has been organized to build a dummy line to Glennan. J. A. KUHN, Dr. GLENNAN, and J. MCINTYRE.

Street Railways.—***Tallahassee, Fla.***—A street railway company is to be organized by G. W. SAXON and others.

Camden, Ark.—A franchise for a street railway has been granted to J. C. CORNISH.

Vernon, Tex.—A street railway is to be built, by R. F. JONES and others. It will be 1 mile long.

Cuero, Tex.—A street railway is projected.

Ogden, Utah.—The street railway is to be extended to North Ogden and the Hot Springs.

Salem, Ore.—A street railway is to be built to North Salem.

London, Ont. The street railway company has material on hand for considerable extensions to be made this spring, but there is some delay in delivering the rails.

Electric Railways.—***Chattanooga, Tenn.***—An electric line 5 miles long is being built. S. W. DIVINE is interested.

Charleston, S. C.—The street railway company proposes to adopt an electric system. For particulars address J. S. RIGG, President.

Dubuque, Ia.—An electric railway is projected. It will be on Main St.

Kearney, Neb.—The Kearney Electric Ry. Co. has been organized to build a belt line. President, GEO. W. FRANK; Vice-President, H. D. WATSON; Treasurer, GEO. R. SHERWOOD; Secretary, C. M. RICE. Capital stock, $100,000.

Waco, Tex.—The Waco Street Ry. Co. is now reported to be contemplating the adoption of an electric system.

Cable Railways.—***Newark, N. J.***—The Market St. cable line must be in operation by July.

Washington, D. C.—The Washington & Georgetown Ry. Co. proposes to put in a cable system at a cost of about $700,000.

Cleveland, O.—The Superior Street Ry. Co. will put in a cable system. For particulars address F. H. ROBINSON, President.

St. Paul, Minn.—A new cable, 1¼ ins. diameter, has been laid on the Selby Ave. line. CLIFT WISE is the engineer.

St. Louis, Mo.—The Chicago syndicate which has purchased the Broadway line, proposes to put in a cable system. The syndicate is headed by Mr. D. G. HAMILTON, Mr. HUTCHINSON of the Corn Exchange Bank, and Mr. HOLMES of the Chicago City Ry.

CONTRACTING.

Cement.—In the list of prices on p. 248 that of A. C. Babson should have been $2.57 instead of $2.37.

Street Work.—***New Utrecht, N. Y.***—The following were bids for grading Marine Ave.: J. J. Morrisey, $13,050; J. Curran, $13,300; John Crook, $13,300; Leighton & Foster, New York, $13,854; T. R. McCann, $16,000.

Dredging.—The following proposals were opened March 15 by Capt. CARL F. PALFREY, U. S. Engineer Office, Oswego, N. Y.:—In Great Sodus bay, N. Y.: Edward J. Hingston, Buffalo, N. Y., 16 9-10 cts. per cu. yd. $8,450; W. S. Malcolm, Jr., Oswego, N. Y., 18 cts., $9,000; Willard Johnson, Fulton, N. Y., 20 cts., $10,000.—In Charlotte harbor, N. Y.: Edward J. Hingston, 16 9-10 cts. per cu. yd., $16,900; Willard Johnson, 19½ cts., $19,500.

Pipe.—The following proposals were received March 12 by B. D. MCCONNELL, Acting Superintendent of Water-Works, at Montreal, for furnishing 1,550 tons of cast-iron pipe (250 tons of 24-in., 850 tons of 12-in., 150 tons of 10-in., 40 tons of 8-in., 240 tons of 6-in., and 20 tons of 4-in.): Anderson & Miller (for P. & W. McLennan), $34.80 per ton $53,940. Gerald Lorner, Jr., Montreal, $34.47, $34.71, $34.98, $35.46, $36.19, $37.39; total, $54,219. B. J. Coghlin (Laidlaw & Son), $35 for 24, 12 and 10-in., $36 for 8, 6 and 4-in., $54,550. Wm. Clendinneng, Montreal (for the Canada Pipe & Foundry Co.) $35.22, $54,591. Thos. Turnbull & Co., Montreal; $36.25, $56,187.50. J. & H. Taylor (for D. W. Stewart & Co., Glasgow): $35.60, $36.10, $37.10, $37.10, $37.30, $37.30, $56,332. Middleton & Meredith (for Thos. Edington & Son, Glasgow): $36.57, $56,683.50. Wm. McNally & Co., Montreal: $36.95, $37.05, $36.90, $36.80, $37, $37.10; $57,350. A. C. Leslie & Co., Montreal: $37.50, $58,125. R. D. Wood & Co., Philadelphia, Pa.: $41 for 24-in., $41.25 for 12, 10 and 8-in., $41.45 for 6-in., $41.65 for 4-in., $63,931. Bellhouse & Dillon (for Cochrane, Grove & Co., Middleboro, England), $34.70 for 12 and 10-in., $35.30 for 8, 6 and 4-in.; $45,290 for 1,300 tons. A. T. Paterson (for Londonderry Iron Co., Londonderry, N. S.): $33.90 per ton for 12-in., $28,815. Contracts were let to the Canada Pipe & Foundry Co., for all but 12-in. pipe; and to the Londonderry Iron Co. for 12-in. pipe.

Sea Wall.—The following proposals for the construction of 1,100 ft. of sea-wall at Governor's Id., New York Harbor, have been received by Lt.-Col. D. C. HOUSTON U. S. Engineer Office, New York City: F. H. Smith, New York: $14.70 per cu. yd. for 375 cu. yds. of foundation; $15 per cu. yd. for 1,450 cu. yds. of wall; 25 cts. per lb. for iron clamps and dowels; total, $27,262.50; blue dolomite. Herbert Steward, New York: $9, $19.08, 25 cts., $31,041. B. Henry Cram, Boston, Mass.: $8.99, $20.99, 19 cts., $33,806.75; Maine stone. John Donaldson, Brooklyn, N. Y.: $6.47½, $22, 5 cts., $34,328.13; granite. W. H. Molthrop, New London, Conn.: $8, $22, 35 cts., $34,900 granite. John T. Rowland, Jersey City, N. J.: $8.87 $22.97, 75 cts.: $36,632.75. Ciancomino's Towing & Transportation Co., New York: $10.20, $23.92; 30 cts., $38,509; granite. M. J. Giblin, New York: $8, $25, 5 cts., $39,250; granite. John Sheehan, David's Id., N. Y.: $10, $26, 30 cts., $41,450; Greenwich granite. Connell, Bradley & McClellan, New York: $16, $25.50, 4½ cts., $42,976; Maine granite.

Sewer Pipe.—The following proposals for vitrified clay pipes and branches have been received by W. E. CUTSHAW, City Engineer, Richmond, Va.: West & Branch, Richmond, Va.: 85, 65, 45, and 30 cts. per ft., list price for 12, 10, 8 and 6-in. pipe, $3.83 for branches; 62½ per cent. discount in carload lots, 55 per cent. discount in less than carload lots; pipe manufactured at East Liverpool, O. John Bowers, Richmond: same prices and discounts; pipe from McMahan, Porter & Co., New Cumberland, W. Va. G. A. Bargamin, Richmond: same prices and discounts. C. N. Cosby & Co., Richmond: same prices, 54 to 60 per cent. discount on less than carload lots; pipe from P. Bannon & Co., Louisville, Ky. Calumet Fire Clay Co., Calumet, O: same prices, 67½ per cent. discount on carload lots, 55 per cent discount on less than carload lots.

Sewers.—The following proposals for the Lake Ave. sewer have been received by the Executive Committee, Rochester, N. Y. The estimated expense of the outlet sewer is $18,000. There were 8 bids for the work, as follows: Michael Ehrstein, $12,203.50; William Fuller, $14,094.90; N. L. Brayer, $14,200; Weider & McMahon, $14,840.35; H. L. & F. W. Jones, $14,968; George Chambers, $15,588.50; Whitmore, Rauber & Vicinus, $16,873.50; Robert Y. McConnell, $17,186.90. Following are the bids for the pipe sewer, the estimated expense of which is $10,000: William Fuller, $6,105.30; George Chambers, $6,437.09; Michael Ehrstein, $6,243.49; Weider & McMahon, $7,295.45; Whitmore, Rauber & Vicinus, $8,344.23; N. L. Brayer, $7,602.02; H. L. & F. W. Jones, $7,993; Robert Y. McConnell, $9,039.05; Dyer & Co., $8,947.70. If all of the contracts are let to the lowest bidders, the total cost of the three improvements will be $86,258.80, which will probably be increased by various extra expenses to $100,000.

Public Building.—The following proposals for the public building at Troy, N. Y., have been received at Washington: Peter H. Buckley, Troy, $204,840 for granite, $157,800 for limestone. $157,850 for sandstone, $169,940 for marble, $197,970 for Oxford bluestone, and $157,880 for Portage bluestone; Edmund Broderick, Troy, $228,000 for granite, $186,000 for limestone, and $186,000 for sandstone. The lowest bid for granite was from McCarthy & Baldwin, Washington, $170,000. The lowest for limestone was Hughes Brothers, Syracuse, $135,900. The lowest for sand stone was McAllister & Dall, Cleveland, $129,638. The lowest for marble was Lane & Matmate, Washington, $154,000. Clinton Smith, Middlebury, Vt., bid $176,749 for marble. The amount of money appropriated for the building is $194,000.

Dump Boat.—The following proposals for the construction of a dump boat for the Great Kanawha river improvement, have been received by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va.: Layton Williams, Malden, W. Va., $1,405.50; J. E. Thayer, Charleston, W. Va., $1,450. The contract was awarded to Layton Williams.

Stone.—The following proposals for furnishing hard gray limestone spalls have been received by the City Clerk, Syracuse, N. Y.: John Conley, $3.45 and $4.80 per cord, in different wards of the city; George O. Stohrer, $3.49 to $5.39; John Kelly, $2.90 to $4.50; Thomas Conley, $3.30 to $4.98; E. J. Clark, $3.70 to $5.25; James Conley, Jr., $3.08 to $5.65; Patrick McNeil, $2.94 to $5.25; Daniel Murray, $3.09 to $4.23.

Asphalt Paving.—The Executive Board, Rochester, N. Y., has received three bids for the asphalt pavement on Lake Ave.: Rochester Vulcanite Pavement Co., vulcanite or Trinidad asphalt, with guarantee for 10 years, $77,950; Henry Bolze, New York, Sicily rock asphalt, with guarantee for 10 years, $83,498.26; Warren Scharf Asphalt Paving Co., New York, Trinidad asphalt, $82,142.61, with 5 years guarantee. The estimated cost was $86,000, and the specifications required a 10 years guarantee.

PROPOSALS OPEN.

Stone, Cement, Pipe.—About 1,450 cu. yds., broken stone; 680 cu. yds. sand; 1,450 cu. yds. gravel; 1,450 bls. domestic cement; 220 bls. Portland cement; 14,800 lin. ft. of 6-in. drain pipe. H. MCLANE, Constructing Engineer, Providence Cable Tramway Co., 45 Westminster St., Providence, R. I.

Curbing.—Sandstone and limestone curbing. L. W. HUGHES, City Clerk, Parkersburg, W. Va. March 28.

Gravel and Sand.—About 1,200 cu. yds. sand, 1,500 cu. yds. gravel and 3,400 cu. yds. gravel screenings; also tapping cocks, boxes, etc. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. March 29.

Water-Works.—Pumping station, 6¼ miles of 10-in. pipe, etc. W. G. JONES, City Treasurer, Temple, Tex. March 30.

Water Works.—Furnishing and laying 1¼ miles of 6-in. and ½-mile of 4-in. A. W. CAWTHON, Chairman Executive Committe, Selma Land Co., Selma, Ala. April 1.

Court House and Jail.—At Plattsburg, N. Y. JAMES AVERILL, Jr., Chairman of Building Committee, care of S. A. KELLOGG, Plattsburg, N. Y. April 1.

Electric Lighting.—For 1 year from May 1. P. J. CUNNINGHAM, City Clerk, Lima, O. April 1.

Sewers.—Manholes, lampholes, vitrified pipe. THOS. J. LANAHAN, Clerk, Board of Contract and Apportionment, Albany, N. Y. April 1.

Electric Lighting.—About 150 lights. THE CITY CLERK, London, Ont., Canada. April 1.

Paving.—Brick or granite. WM. STEYH, City Engineer, Burlington, Ia. April 1.

Street Work.—Belgian block paving; blue stone curb, JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. April 2.

New Croton Aqueduct.—Masonry aqueduct from the new gate-house at 135th St. and Convent Ave, to a point in 10th Ave. and 135th St. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York. April 3.

Dredging.—In Vicksburg harbor. Capt. WM. T. ROSSELL, U. S. Engineer Office, Memphis, Tenn. April 3.

Bonds.—Sewer bonds for $200,000. H. E. BRYAN, City Clerk, Columbus, O. April 3.

Bridge.—Iron bridge, 60 ft. long. FRANK J. O'FLAHERTY, County Surveyor, Water-Works Building, Kansas City, Mo. April 6.

Pipe and Hydrants.—Water pipes and hydrant at the Norfolk naval hospital to connect with the water system of Portsmouth, Va. J. MILLS BROWNE, Surgeon General, U. S. N., Navy Department, Washington, D. C. April 8.

Dike.—Repairing dike on Nansemond river. Lieut. G. J. FIEBEGER, U. S. Engineer Office, Norfolk, Va. April 8.

Pipe Laying.—Laying main to the new reservoir; also 44 tons of lead. THE BOARD OF PUBLIC WORKS AND AFFAIRS, Nashville, Tenn. April 11.

Street Work.—Grading, Medina paving and culverts. W. P. RICE, City Engineer, Cleveland, O. April 11.

Dredging.—At mouth of Black river, Port Huron, Mich. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. April 18.

MANUFACTURING AND TECHNICAL.

We learn the suit of the Hyatt Pure Water Co. against the Jewell Pure Water Co. has been discontinued in the United States Court of the Northern District of Illinois, as the same issue is being tried in the United States Circuit Court, District of New Jersey.

Ice Machine.—A water-wheel has been shipped to St. John, Porto Rico, to furnish power for a large Mayer ice machine which is to be erected for Spanish parties under the direction of an American engineer, who is now superintending the construction in this city. It is the intention of the parties at Porto Rico to furnish ice for home consumption, and for the European steamers which stop at the island on their way to and from Gulf and southern ports.

Switches.—The Parsons Railway Crossing Protector, Switch & Frog Co. is building works at Joliet, Ill., for the manufacture of an interlocking switch and signal apparatus.

Pole Roads.—The Richmond Cedar Works Co., of Greenville, Ala., will build a pole road 13 miles long.—Stallings & Wilkinson, of Greenville, Ala., will build a pole road to Leon and Andalusia.

Gas Motors.—The Northwestern Street Ry. Gas Motor Co. has been organized at Chicago by F. A. BATES, E. F. GETCHELL, and JEFFERSON HODGKINS.

Springs.—Anderson, DePuy & Co., of Pittsburg Pa., have a contract for 300 tons of spiral springs for the 2,000 cars to be built by the Pennsylvania R. R. Co.

Rails.—The North Chicago Rolling Mills have an order for heavy steel rails for the Denver & Rio Grande.

Pipe Works.—It is proposed to establish works at Minneapolis, Minn., for the manufacture of water and gas pipe. GEO. E. BEACH is the promoter.

Steel Works.—The new steel plant of the Phœnix Iron Co., at Phœnixville, Pa., was put in operation March 4.

The Reading Iron Works Co., of Reading, Pa., failed recently with heavy liabilities. The company had a paid-in capital of $1,050,000 and did a large business. The failure is attributed to the condition of the iron trade. The Philadelphia & Reading has entered a judgment for $140,000.

Flush Tanks.—The Flush Tank Co. recently organized at Chicago, Ill., manufactures the only automatic siphons operating without moving parts; it controls the patents of Rhoads, Rogers-Field, Waring, Williams, Kuntz and others. Mr. BENEZETTE WILLIAMS, who was

in charge of the sewerage at Pullman, Ill., is President. The office is at 160 La Salle St., Chicago.

The North Carolina Pine Lumber Co. has been organized at Norfolk, Va. The capital stock is to be not less than $25,000, nor more than $500,000. President, W. W. TUNIS; Vice-President, JOHN L. ROPER, of Norfolk; Secretary, HOWARD N. JOHNSON.

Filters.—The National Water Purifying Co., of New York, will soon have its filters in operation in the office buildings of the New York Life Insurance Co. at Chicago and Kansas City.

Signals.—The Johnson Railroad Signal Co., of Rahway, N. J., has opened an office in the Rock Island building, Chicago, where it has several specimens of its signaling and interlocking appliances on view. The works at Rahway have been enlarged.

The King Automatic Railway Signal Co., of Greenville, S. C., has been organized. President, H. C. BEATTIE; Secretary, J. F. RICHARDSON.

The parabolic semaphore signal invented by C. H. KOYL, of Swarthmore, Pa., is now being tried by the Philadelphia & Reading, West Shore and Lehigh Valley roads. A company is to be organized to undertake the manufacture. The signal was described on page 396 of ENGINEERING NEWS, Nov. 17, 1888.

The Waddell Automatic Electric Railway Signal Co. has been organized at Lexington, Va., to manufacture a patent electric signal and collision preventive apparatus. President, F. T. GLASGOW; Secretary, W. H. WADDELL.

Water Columns.—At the recent convention of the National Electric Light Association, at Chicago, Ill., the Reliance Gauge Co., of Cleveland, O., had an exhibit of the Reliance safety water columns, including low and combined high and low water alarms, with patent solderless floats, etc.

Pumps.—The Laidlaw & Dunn Co., of Cincinnati, O., has an order from Francis Whitaker & Sons, of East St. Louis, Ill., for standard duplex pumps for their new packing house at Wichita, Kan. The Laidlaw & Dunn Co. has also sold two 300 H. P. Galloway boilers to the Geo. H. Friend Paper Co., of West Carrollton, O.

Marine Engines.—The only bid received by the Navy Department for the construction of the machinery for the new cruiser *Maine* was from the Quintard Iron Works, New York, at $735,000.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have recently shipped 4 engines to Brazil, 4 to Cuba, 7 to Chili, and 10 to the Argentine Republic, the latter being part of an order for 30. For home trade, 3 passenger engines have been sent to the Raleigh & Augusta, 2 moguls to the Anniston & Cincinnati, and 1 passenger engine to the Lynchburg & Durham. An order for 10 engines for the Philadelphia & Reading is now on hand.

Railway Material.—R. F. Jones, of Vernon, Tex., wants rails and cars for 1 mile of street railway.

A. B. Coe, of Chattanooga, Tenn., wants 1 mile of second-hand steel or iron rails, 20 to 30 lbs. per yard.

J. A. Gaboury, General Manager of the Jacksonville, Williamsport & Anniston Ry., Jacksonville, Ala., wants 20 miles of steel rails, 4 engines and 6 passenger cars.

The Southern Construction & Quarry Co. will build a railway 3 miles long to its quarries.

Boring Plant.—Wm. Phipps, of Hartford, Ky., has leased land on which to bore for oil and gas, and wants bids for the necessary plant.

Steel Ties.—A company has been formed to manufacture the Hartford tie, which is to be tested shortly on the New York Central. President, E. N. DICKERSON; General Manager, A. J. HARTFORD; Secretary, GEO. A. WEBER. The office is at 74 Fifth Ave., New York.

Car Notes.—The South Baltimore Car Works, of Baltimore, Md., have an order for 750 freight cars for the Richmond & Danville.

The Gilbert Car Works, of Troy, N. Y., has shipped 2 cars to the Union road, at Chattanooga, Tenn., and 2 cars to the Delaware & Hudson.

The St. Charles Car Works, of St. Charles, Mo., are building box, flat, and dump cars for the Kansas City, Memphis & Birmingham.

The Ohio Falls Car Co., of Jeffersonville, Ky., has orders for 20 flat cars for the Midville, Swainsboro & Red Bluff, 40 coke cars for the Tennessee Coal, Iron & Ry. Co., several cabooses for the Kansas City & Pacific, and freight cars for the Lynchburg & Durham. Nearly 400 of the 1,000 freight cars for the Pennsylvania road have been completed, and the rest are being turned out at the rate of 18 or 20 per day.

Iron Works.—The Warwick Iron Works, of Newport News, Va., will be enlarged. Engines and machinery of all kinds, creosoting plant, locomotives, etc., will be built. Mr. WM. SIMPKIN, formerly Superintendent of the Richmond Locomotive & Machine Works, has entered into partnership with the firm.

The Ross-Meehan Brake Shoe Co. has completed its works at Chattanooga, Tenn.

A Dummy Engine on a new system has been built by THOMAS ROGERS at the Richmond Locomotive & Machine Works, Richmond, Va.

Steel Works.—The North Chicago Rolling Mill Co., the Union Steel Co., and the Joliet Steel Co. have been consolidated, with a capital stock of $20,000,000.

BRIDGES AND CANALS.

Bridges.—*Alstead, N. H.*—An iron bridge is to be built across the Cold river.

Newton, Mass.—An appropriation of $16,000 has been made for a new bridge at Lower Falls and Nonantum.

Brockton, Mass.—The Highway Committee will advertise for proposals for the construction of iron bridges at Plain and Court Sts. and Perkins Ave., and a wooden bridge at Ames St.

Pittsburg, Pa.—The work of constructing the new Wilmot St. bridge, for which $25,000 was provided in the appropriation ordinance this year, has been begun. The contract for abutments was awarded to Gianini & Jones.

Duquesne, Pa.—The McKeesport & Duquesne Bridge Co. will soon begin work on the Monongahela river bridge.

Front Royal, Va.—Bridges are to be built over the North and South branches of the Shenandoah river. They will be 350 and 500 ft. long, and will cost about $30,000 or $25,000. For particulars address the mayor, W. P. KING.

Wheeling, W. Va.—Work is progressing on the Ohio river bridge of the Wheeling & Harrisburg Ry.

Piedmont, W. Va.—The new Cumberland & Pennsylvania railway bridge is nearly completed.

Pineville, Ky.—The West Pineville Land & Improvement Co. will build a steel bridge across the Cumberland river.

Jacksonville, Fla.—M. S. Carter & Co. have commenced work on the piers of the St. John's river bridge.

Sioux City, Ia.—The Pontoon Bridge Co. has promised to have its bridge completed by May 15.

St. Louis, Mo.—For the improvement of the Catlin tract an iron bridge 100 ft. wide will be built at a cost of $10,000.

Renton, Wash. Ty.—The contract for the Howe truss bridge over Black river has been let to Hoffman & Bates, of Portland, Ore., at $2,950.

Los Angeles, Cal.—A number of new bridges are being built. Cable lines will cross some of them.

Kansas City, Mo.—The following contracts were awarded March 11 by FRANK J. O'FLAHERTY, County Surveyor: Bridge across Indian creek at Santa Fé crossing; one span of 80 ft., 2 stone piers 17 ft. high, 80 ft. of trestle approach at each side; roadway 18 ft. wide; Kansas City Bridge & Iron Co., $2,875: to be completed in 90 days from date of contract.—Bridge across ravine on the Raytown road; one span of 30 ft., abutments and wings, roadway 18 ft. wide; Wrought Iron Bridge Co., Kansas City, $900.

Canals.—The Real Estate Exchange, New York City, has passed a resolution recognizing the importance of the Harlem ship canal.

The report on the New York State canals for the year ending Sept. 30, 1888, by State Engineer BOGART, has been submitted to the Legislature. The freight carried amounted to $4,492,948.

Water was let into the Cumberland division of the Chesapeake & Ohio canal on March 14.

Norfolk & Western Railway.—Cofrode & Evans, of Pottstown, Pa., contractors for the trestles and bridges on the Clinch Valley division west of Tazewell C. H., Va., have completed trestles 26 to 31 inclusive, and bridges 4 to 7 inclusive. Bridge No. 8 is about completed, and its completion will enable track to be laid to Pounding Mill station, 31 miles west from Graham, by April.

ELECTRICAL.

Bowling Green, O.—The following bids for electric lighting have been received by the City Council:

Silvey Electric Light Co., of Lima: 20 lights at $75 each, any over, $20 for 3 years, and afterward $70 for all; 2,000 c. p.; brick building to be erected and 100 H. P. power plant. To pay $100 a year for gas.—Bowling Green Electric Light & Power Co.: $80 for 20 or more lights, of either the Western, Thomson-Houston or Brush systems.—G. L. Colgate, of Cincinnati: $100 for Thomson-Houston system; 5-year contract, and to pay $100 a year for gas.—F. F. Graves, of Toledo: $75 a light for 20 or more lights, of either the Western or Thomson-Houston system; 5-year contract, and to pay $100 a year for gas.

The Western Electric Co. has made its headquarters in its large building at Greenwich and Thames Sts., New York.

The Earnest Electric System.—Mr. WILBUR A. GINN, City Engineer of Sidney, O., has completed drawings of the Earnest underground system as applied to street railways, electric lighting, telephones, etc.

Electric Light.—*Nashua, N. H.*—The city has made a 3 years' contract with the electric light company for arc lights of 1,200 c. p. at $84 per annum each.

Newton, Mass.—The city has contracted with the gas company for 72 arc lights of 1,200 c. p. at $100 per annum and 450 incandescent lights of 25 c. p. at $13.50.

Brooklyn, N. Y.—The aldermen have rejected a resolution to reduce the price per electric light from $182.50 to $125, and the contracts have been renewed at the old price.

Martin's Ferry, W. Va.—The city has made a 3 years' contract with the Martin's Ferry Construction Co. at $90 per annum for each incandescent lamp and $90 for each arc lamp.

Nashville, Tenn.—The Capital Electric Co. has a contract to put up not less than 100 lights of 2,000 c. p. before June, at 23½ cts. each.

Wilmington, N. C.—The North Carolina Electric Co. has bought out the electric light company and has ordered plant from the Thomson-Houston Co. President, H. A. BURR; Secretary, W. L. SMITH; General Manager, E. P. BAILEY.

Chester, S. C.—The Chester Electric Light & Power Co. has been incorporated by WM. M. NICHOLSON, G. J. PATTERSON, J. J. MCCLURE and others. Capital stock, $5,000.

Marietta, O.—The city has accepted the bid of the Jenney Electric Light Co., of Indianapolis, Ind., for $10,625 for a complete plant for 55 lamps.

Springfield, Ill.—Proposals have been received as follows: Keystone Construction Co., 5 years, 800 to 1,000 incandescent lights of 16 or 25 c. p., $15 or $23.75 per year 125 to 15 arc lights of 2,000 c. p., $148 each. Excelsior Electric Co., 10 years, 150 arc lights at $141.50. Brush Electric Co., 120 arc lights, $96 or $108 for 10 or 5 years' contract. A. L. Ide & Son, 10 years, $137 each for 150 arc lights of 2,000 c. p. W. W. Tracey, 100 arc lights at $107 or $115 for 10 or 5 years contracts.

Whatcom, Wash. Ty.—The Bennet Co. has made a proposition to light the city at $2 and $12 per month for lights of 16 and 2,000 c. p.

Belton, Tex.—The Belton Light & Water Co. will put in a plant on the Heisler system.

Electric Light Companies.—Harvard Electric Light Co., of Harvard, Ill.; capital stock, $16,000. W. F. FAY, J. EASON, E. D. STILES, and others.

Belleville Electric Light & Power Co., of Belleville, Ill.; capital stock, $25,000. J. A. DAY, ADAM KARR, E. ABEND, and others.

South End Electric Light Co., of Chicago: capital stock, $30,000. F. D. FOSTER, G. FALKENBERG, J. H. THOMPSON, and others.

Lewistown Electric Light, Heat & Power Co., of Lewistown, Ill.; capital stock, $10,000. D. D. TABOT, L. W. ROSS, J. M. STUART, and others.

Ashland Electric & Power Co., of Ashland, Ore.; capital stock, $15,000. FORDYCE ROPER, H. B. CARTER, S. B. GALEY, and others.

Lockport, N. Y.—The Common Council recently made a contract with the gas company for electric lighting, but the matter was vetoed by the mayor. General opinion is in favor of the city putting in its own plant.

WATER AND MUNICIPAL.

Detroit, Mich.—The Water Commissioners have instructed Secretary L. N. CASE and Superintendent HENRY BRIDGE to officially call attention to the unnecessary waste of water. They have drawn up a circular, which will be sent to every user of water in the city. In it they place the waste at 500,000 galls. daily, with an additional waste of 8,000,000 galls. in the heated term and 16,000,000 during the cold months; 74 galls. per capita is placed by experts as a generous supply. Allowing 100 galls. per capita, the water-works are pumping a quantity sufficient to supply twice the population of the city. The waste must be stopped or the capacity of the works increased. An increase in capacity would involve an outlay of $300,000 for a new supply main, $100,000 for a new engine, and about $200,000 for new boilers, houses, labor, etc. Meters will be placed at breweries and livery stables.

Sacramento, Cal.—Mr. P. A. HUMBERT, engineer of the Folsom Water Co. has submitted a special report on the water supply. He condemned the proposition of supplying the city from wells, as he thought the water likely to be contaminated. The present pumping machinery is in good condition, but inadequate, and he recommends the purchase of a duplex compound engine of 10,000,000 galls. daily capacity; and advises that instead of repairing the old city tank, a large stand-pipe be erected and that a filtering system be adopted. The estimate for the engine, stand-pipe, and filter plant is about $250,000. The Water Committee of the Improvement Association is in favor of the wells and a Hyatt filter plant.

East Saginaw, Mich.—The Board of Public Works has issued its report for 1888. The report of the clerk gives particulars of the cost of the several public works, and the report of Mr. J. J. GRANVILLE, City Engineer gives particulars of the character and cost of the work.

Garbage Cremation.—At Savannah, Ga., it has been decided to adopt the cremation system for garbage disposal, and a contract has been made with the U. S. Gas & Fuel Co., of Philadelphia, Pa.—At Macon, Ga., the Board of Health is contemplating the adoption of a cremation system. For particulars address the mayor.—At Brunswick, Ga., the City Council proposes to adopt this system.

Springfield, Mass.—The report of the Water Commissioners for 1888 has been published. The work on the distribution system was as follows: 34,919 ft. of cast-iron and wrought-iron pipe added, 16,896 ft. of cement lined and wrought-iron pipe taken out; a net addition of 3.4 miles; 79 gates set and 26 taken out; 41 hydrants set and 13 taken out; there are now 84.97 miles of pipe, 776 gates

and 627 hydrants, 70 of which are private. Several filtering systems have been investigated, but the Board does not feel justified in making any recommendation. The consumption of water was 1,460,000 galls., of which 7.99 per cent. was metered. J. C. HANCOCK is Superintendent.

London, Ont.—Contracts have been awarded as follows by Mr. THOS. H. TRACY, M. Can. Soc. C. E., Superintendent and Engineer of the water-works: John Sharp, Delaware: hard and soft wood, $4.70 and $3 per cord. Stevens & Burns, London: laying 4-in. and 6-in. pipe, 49½ and 73 cts. per ft.: 4-in. and 6-in. valves, $13.50 and $18 each; iron valve chambers, $5 each; brass, $251. Cryer & Co., London: hydrants, $32 each. Bowman & Co., London: coal, $5 to $5.80 per ton: Portland cement, $4 per bl. W. Willis, London: pine lumber, $14 per M. J. Woodhull, Westminster: white oak, $30 per M. James Cowan & Co., London: lead pipe, $4.98 per 100 lbs.; cut and assorted nails, $2.70 and $3 per 100 lbs.; wrought spikes, $4 per 100 lbs.; screws, 20 cts. per gross; cut spikes, $2.70 per 100 lbs.; also oil, paint, waste, and hardware.

Fresno, Cal.—The following proposals have been received by the City Trustees:—For furnishing water for flushing the sewers; W. S. McMurtry, $4,800 per annum; C. D. Vincent, $5,375; Alexander McBean, $5,375.—For sewage disposal: Alexander McBean, of San Francisco, $4,900 per annum for 5 years; C. D. Vincent, of San Francisco, $5,800. The contract was awarded on Feb. 25 to A. McBean. W. B. DENNETT is City Clerk.

Seymour, Ind.—Willet E. McMillan, who has the franchise for a water-works system, will shortly require 2 compound, duplex, direct acting steam pumping engines with a combined daily capacity of 3,000,000 galls.; 2 boilers of 75 H. P. each, set up, with all fixtures; also a stand-pipe 100 ft. high and 16 ft. diameter, the foundation of which he will construct. There will be 10 miles of mains.

Redondo Beach, Cal.—The water-works plant of the Redondo Beach Co. consists of a compound Worthington pump of 1,500,000 galls. daily capacity, with one 40 H. P. boiler. The water supply is drawn from 32 wells, all connected by a system of suction pipes, so that the water is drawn from each well alike. A constant test, at the rate of 600 galls. per minute, fails to perceptibly lower the water, thus assuring to the town an abundant supply of pure and soft water. The water mains are of 8 and 6-in. cast and lap-welded pipe. The reservoir is 164 ft. above the works and 148 ft. above the hotel site. It is of concrete throughout, with sides 12 ins. and a bottom 6 ins. thick. It is 110 ft. long, 105 ft. wide on the bottom, and 18 ft. deep. The reservoir has a capacity of 3,000,000 galls.

Salt Lake City, Utah.—The mayor has called attention to the necessity of an increased water supply and recommends the construction of reservoirs. With regard to the waste and meters, he says: "That the extraordinary and wanton waste should and can be curtailed, I am firmly convinced. In the first place, I am not satisfied with the test heretofore made of the water meter. The instrument was placed in the City Hall cellar; it seemed to register correctly for a while, but after a brief period, corrosive substances in the City Creek water, acting on the metallic workings, clogged the instrument and destroyed its usefulness. But little water is used at the City Hall, and the chance of corrosion is therefore greater than at some place where the activity of the water would largely prevent the accumulation of the corroding elements. Different kinds of meters might be tested, also. I am informed there is one made of gutta percha, which is particularly adapted to waters possessing the properties common to our mountain streams. I would not advocate the general use of meters, but at places where there is the greatest waste they might be put in with beneficial results. If there were one at every railway station, hotel, livery stable and laundry in the city, and payment were to be exacted at the rate of 20 cts. for each 1,000 galls. of water used, as the ordinance provides, I am confident the water question would present a much less formidable aspect. I am also convinced that, by the use of self-closing water cocks at the supply taps most frequently used, much water might be saved."

Charleston, S. C.—The main source of the water supply is from the artesian wells. One well is 1,970 ft. deep, 2¼ ins. diameter at the bottom, and flows 300,000 galls. per day; another is 1,950 ft. deep, 3¼ ins. diameter at the bottom, and flows 400,000 galls. per day. The third well is 1,835 ft. deep and is to be 2,000 ft.; it is expected to yield 1,000,000 galls. per day; this well is lined with iron tubing 12 ins. to 6 ins. diameter.

Drainage in Minnesota.—A bill is before the State Legislature authorizing an annual appropriation of $25,000 for 4 years for the drainage of the Red River valley lands in Wilkin, Clay, Norman, Polk and Marshall counties. The St. Paul, Minneapolis & Manitoba Ry. Co. is to pay an amount equal to one-fourth of the State appropriation.

Chicago, Ill.—The following bids for lighting the outlying portions of the city with gasoline have been received by the Committee on Gas, Oil and Electric Light: Northwestern Globe Gaslight Co., gasoline, present schedule, $19.20 per lamp per year; moonlight schedule, $16.50; Home Illuminating Co., gasoline, $20; Globe, Light & Heat Co., gasoline, retort burner, $20; single shower burner, $18.40; Western Wheeler Reflector Co., vapor burner, $17.79; oil, $18.50. The contract was awarded to the Northwestern Globe Gaslight Co.

Steam Heating.—The Mutual Steam Heating Co. has been incorporated at Philadelphia, Pa., by HENRY CLAY, JAMES MCMANES, DAVID H. LANE, JACOBUS P. BOWER, Jr., and FREDERICK W. ROEBLING. Capital stock, $1,000 000.

Water Power.—The Water Power Association of Illinois has been organized at Aurora, Ill., to protect the water power interests of the State. President, Hon. M. B. CASTLE, of Sandwich; Secretary, WM. GEORGE, of Aurora.

At Eau Claire, Wis., it is proposed to form a new corporation to control and develop the water power, and to establish a power station from which power can be distributed by electricity to manufacturing institutions.

At Spokane Falls, Wash. Ty., an electric light and power company has purchased a tenth part of the power of the lower falls, with the abutting property, for $250,000. Works will be built at a cost of $250,000.

At Winnipeg, Man., it is proposed to organize the Manitoba Water Power Co. for the purpose of constructing and maintaining dams, locks, canals, and works on the Assiniboine river, in the vicinity of the city, necessary to use and make available for the milling, manufacturing, and other purposes of the company the waters and water power of the said river, and for improving the navigation of said river by connecting same with Lake Manitoba or other bodies of water.

Nashville, Tenn.—The machinery at the new pumping station was put in operation March 13. The engine is of Holly-Gaskill type, 700 H. P., and cost $100,000. The 4 steam cylinders are 66 and 33 ins. diameter; they drive beams weighing 32 tons each, which have connecting rods 20 ft. long, and 6 ins. diameter to the fly-wheel shaft. The fly-wheel is 24 ft. diameter, and weighs 30 tons; it makes 10 to 14 revolutions per minute. The pumping shaft is about 15 x 20 ft., 55 ft. deep; at the bottom are the 4 pumps, which force the water up two 18-in. pipes which unite above in one 36-in. pipe leading to the 36-in. mains. The daily capacity is 10,000,000 galls. There are 6 boilers.

Sewerage.—*Bristol, R. I.*—At a recent town meeting a resolution was passed appointing MESSADORE T. BENNETT, C. H. R. DORINGH, JAMES LAWLESS, CHARLES T. HERRESHOFF, EDWARD W. BRUNSEN, and others, a committee to investigate what they shall deem the most feasible and economic plan for the proper sewerage of the town, and to carry the same into effect, to the extent only of such appropriation or appropriations as may be made for the purpose, and to apply to the General Assembly for any and all powers that may be necessary to carry the above into effect.

Northampton, Mass.—The sewer commissioners have chosen the following officers: President, A. L. WILLISTON; Clerk, E. I. CLAPP; Engineer and Superintendent, W. W. STRONG.

Easthampton, Mass.—The appropriation for sewers this year is larger than usual, as a considerable amount of sewer work is to be carried out.

Newark, N. J.—Serious breaks have occurred in the long wooden flume leading from the pumping station of the intercepting sewer to the bay.

Baltimore, Md.—The Highway Committee has recommended appropriations of $370,000 for the Rush St. sewer, $175,000 for the Fremont St. sewer, and $56,300 for the Light St. sewer.

Norfolk, Va.—The city will spend $70,000 in extending and improving the sewerage system.

Anniston, Ala.—An appropriation has been made of $100,000 for sewers.

Shelby, Ala.—A sewerage system is projected. For particulars address the Shelby Iron Co.

Bessemer, Ala.—The city has issued bonds to pay for the extension of its sewerage system.

Greenville, Miss.—A sewerage system is to be put in by a company organized by W. A. POLLOCK and others.

St. Paul, Minn.—The Board of Public Works has approved the construction of two new sewers at costs of $58 000 and $134,000.

Sioux Falls, Dak.—It is reported that about $75,000 will probably be expended for sewers this year.

Walla Walla, Wash. Ty.—The estimated cost of the new sewerage system is $165,000.

Water-Works.—*Maine.*—Boothbay Harbor. This is a newly organized town and water-works are to be put in.

New Hampshire.—Keene. The city has appropriated $5,000 for relaying cement pipe with iron.

Massachusetts.—Pittsfield. Work on the new main to the Ashley reservoir will be commenced shortly.—North Adams. The Water Supply Committee of the State Legislature have reported the bill authorizing North Adams fire district to take the water of Broad brook and its tributaries in Williamstown, for the purposes of supplying the inhabitants of North Adams, Blockinton and a part of Williamstown with water.—Northampton. The Water Commissioners have reorganized with the following officers: President, D. W. BOND; Clerk, H. A. KIMBALL; Treasurer, OSCAR EDWARDS; Superintendent, J. M. CLARK.

Connecticut.—Manchester.—The town has voted to contract with the water company for 35 hydrants at $90 per annum.

New York.—Palmyra. Bassett Bros., of Buffalo, the contractors for the water-works, will commence construction shortly.

Maryland.—Hagerstown. The Washington County Water Co. will issue 20-year bonds for $40,000; they are to pay off the bonded indebtedness, and will be secured by first mortgage.

Florida.—Orlando. The Orlando Water Co. is extending its distribution system. Mr. DITMAN is in charge.

Mississippi.—Greenville. The City Council is reported to have annulled the contract with the water-works company, on account of its having failed to give the required bond. A contract is to be made with the new water company noted last week.

Kentucky.—Russellville. The Commonwealth Construction Co., of Philadelphia, Pa., has applied for a franchise for water-works.—Danville. Water-works are projected.—Catlettsburg. Water-works are projected and correspondence with contractors is invited. There will be a reservoir and 3½ miles of main. Surveys and estimates have been made. For particulars address C. W. BERGEN.—Georgetown. A proposition has been made to build water-works. For particulars address S. DAVIS, Chairman of the Board of Trustees.

Ohio.—Fostoria. On March 13 the City Council granted a franchise to Moffett, Hodgkins & Clarke, of Watertown, N. Y., to build water-works. There will be a reservoir of 80,000,000 galls. capacity, 16 miles of pipe and 192 hydrants. Annual rental, $7,800.

Michigan.—Marshall. Material for the new water-works has been delivered.—Wyandotte. A vote on the water-works question will be taken April 1.

Illinois.—Carlinville. Work will be started shortly on the new water-works.—Galesburg. The plans for the water-works have been completed. The supply will be taken from a well 30 ft. diameter and 50 ft. deep. The cost will be about $30,000.—Springfield. The Council has passed the ordinance to submit to a vote of the people at the April election the question of increasing the source of water supply by building additional galleries at a cost not to exceed $10,000, to be paid out of the earnings of the water-works.

Iowa.—Dunlap. Water-works are needed, but no action has yet been taken towards securing them.

Nebraska.—Crab Orchard. Water-works are projected.—Wahoo. The water question is again being agitated.—Madison. The new works will be commenced in the spring.

Arkansas.—Helena. The city will have works built at a cost of $60,000.

Texas.—Temple. Proposals for water-works will be received until March 30 by W. G. JONES, City Treasurer The Temple Water-Works Co is said to be making preparations to begin work.—Baird. Water-works are projected.—Cuero. Water-works are projected. For particulars address the mayor.—Fort Worth. Additional driven wells will be put down for an increased supply and a new pumping engine of 6,000,000 galls. daily capacity put in.—Dallas. Two storage reservoirs are being built, and a Gaskill engine of 8,000,000 galls. daily capacity is to be put in; 5 miles of 4 and 6-in. mains will be laid.

Colorado.—Raton. A new well has been put down to furnish an increased supply.—Pueblo. The City Council has authorized the north side trustees to issue water bonds for $150,000.—Trinidad. It is proposed to obtain a supply of spring water from Raton peak.—Denver. Fairbanks & Co. have the contract for the pumping plant, boilers, etc., for East Capitol Hill, at $15,000. The South Capitol Hill Water-Works Co. has been incorporated by E. K. WHITEHEAD, A. WHITEHEAD, and C. F. WILSON. Capital stock, $10,000. The supply will be taken from an artesian well, and distributed through 10,000 ft. of pipe.

Oregon.—Weston. It is proposed to issue bonds for $10,000 to build water-works.

California.—Wheatland. Water-works are to be built.

Utah.—Nephi. Water-works are to be built, at an estimated cost of $25,000. The supply will probably be taken from a mountain spring 3 miles distant. Surveys and plans have been made by M. F. STURGES, C. E., of Salt Lake City.

Canada.—Wiarton, Ont. The following proposals have been received for extending the water-works: Burns & McCormick, Toronto, $3,359; T. C. Dinsmore, Wiarton, $4,350; Hardy & Leathorn, London, $4.400; M. Stephens, Collingwood, $4,600; Nellis & Beard, Toronto, $4,780.84; Geo. Sinclair, Wiarton, $5,500; J. D. Ronalds, Brussels, $6,500.—Winnipeg, Man. The water-works Company has ordered from the National Water Pumping Co., of New York, an additional filter plant of 500,000 galls. daily capacity, being the second addition to the original plant. The water company will probably purchase valves, etc., in connection with the enlargement of its plant.